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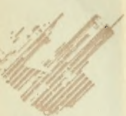
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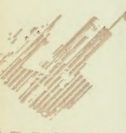
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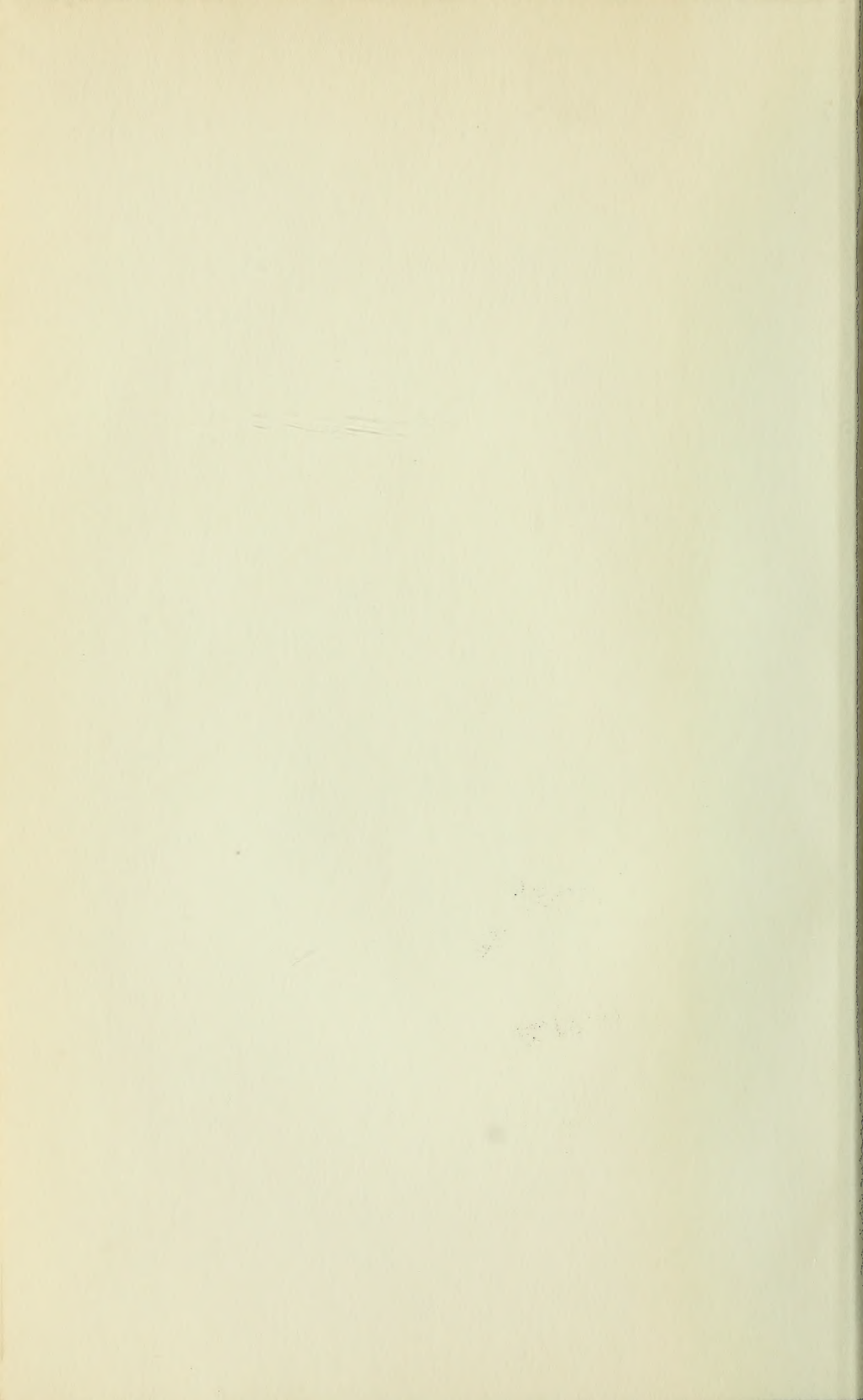


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Bulletin 93

ECONOMIC GEOLOGY 13

THE MINING AND QUARRY INDUSTRY

OF

NEW YORK STATE

BY

DAVID H. NEWLAND B.A.

Assistant State Geologist

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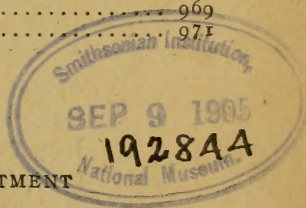
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New York State Education Department

Science Division, April 25, 1905

Hon. Andrew S. Draper

Commissioner of Education

MY DEAR SIR: I beg to transmit herewith for publication as a bulletin of the State Museum a report entitled, *The Mining and Quarry Industry of New York State: Report of Operations and Production during 1904*, by David H. Newland, Assistant State Geologist.

Very respectfully yours

JOHN M. CLARKE

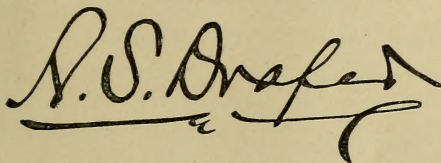
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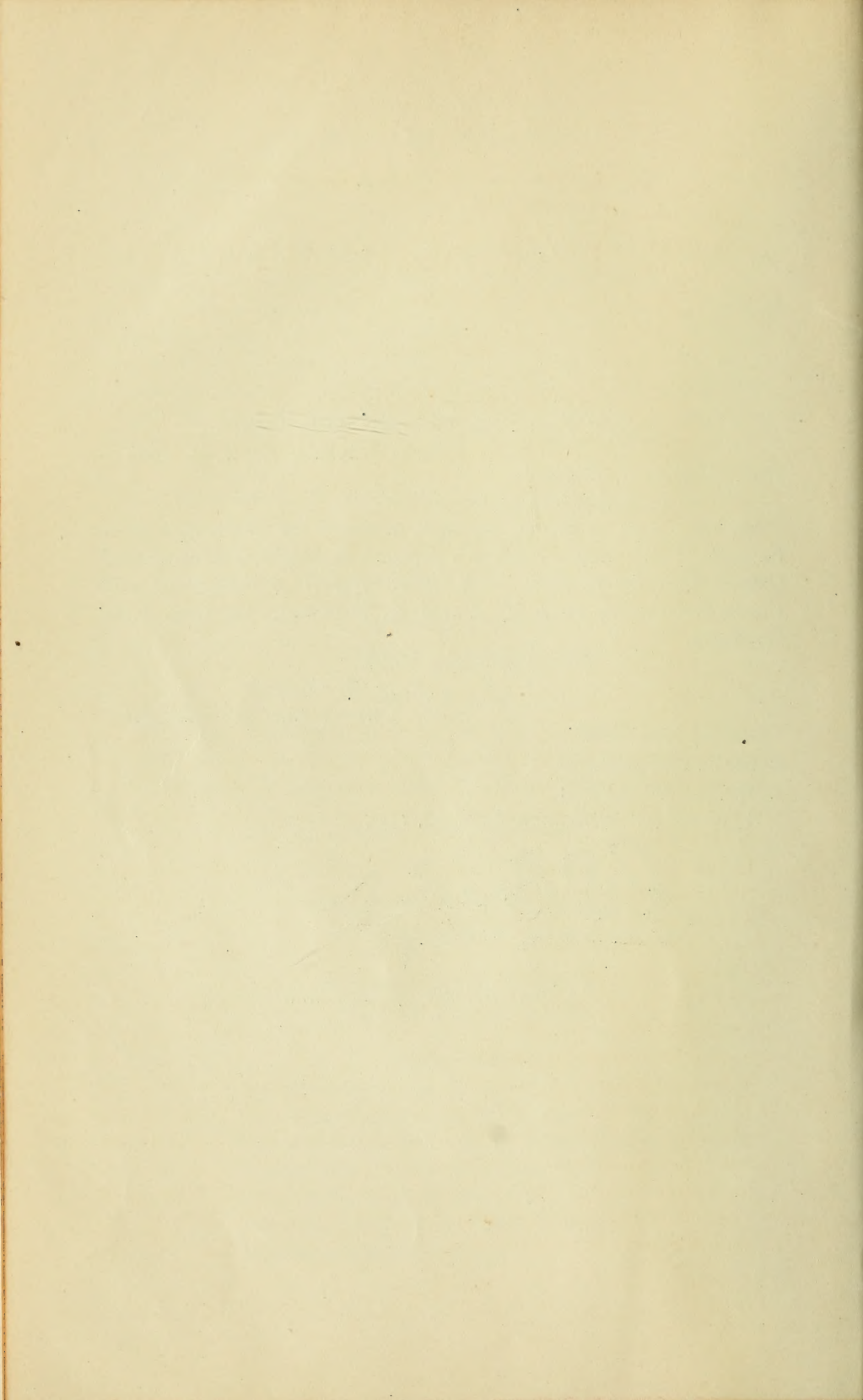
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Approved for publication April 26, 1905

A handwritten signature in dark ink, reading "A. S. Draper". The signature is written in a cursive style with a long, sweeping underline that extends to the right.

Commissioner of Education



New York State Education Department

New York State Museum

JOHN M. CLARKE Director

Bulletin 93

ECONOMIC GEOLOGY 13

THE MINING AND QUARRY INDUSTRY

OF

NEW YORK STATE

REPORT OF OPERATIONS AND PRODUCTION DURING

1904

PREFACE

This bulletin is intended to present a summary of the mineral resources of New York and their economic development. It covers the principal facts regarding the character, occurrence and production of the useful minerals, with brief discussion of existing conditions in the related industries.

In many departments of the mineral industry a notably increased activity has been manifest during the last few years, and to meet the requests for information that are constantly received it has seemed advisable to undertake a more elaborate investigation than has been attempted hitherto. For that purpose a statistical canvass has been made of the mines and quarries throughout the State. The data incorporated in the following pages are based mainly on information thus obtained.

Acknowledgment for assistance is due to those engaged in mining and quarry enterprises; the requests for statistics and other details of operations have met uniformly a considerate response that has greatly facilitated the investigation.

In communicating with the various producers use has been made of the list of mineral producers compiled in 1904 by Dr F. J. H. Merrill, formerly State Geologist.

INTRODUCTION

The mineral wealth of New York is overshadowed by that of some states, but it is nevertheless a great natural endowment. According to the reports of the Census office at Washington, New York ranked 13th in 1902 in value of mineral production. The total as compiled in the reports, however, does not take into account the clay products (classed as mineral manufactures), the value of which is more than one half that of all other materials combined. In manufactures based on substances taken from mines and quarries, the State was second with an aggregate of approximately \$500,000,000, which represented 23 per cent of all its manufactures for the year.

The useful minerals that are produced, numbering over 20 in all, are derived from a great number of localities distributed throughout different sections. Nearly every county of the State is represented by one or more branches of the industry. Building stones and clays are naturally the most abundant and the most extensively exploited. Of the former all the principal commercial varieties occur, including many stones that are prized for monumental and decorative work. Black, red and green roofing slates are quarried in Washington county. Cement materials of high excellence occur in inexhaustible quantities. In the manufacture of natural hydraulic cement the State has long held the leading position, while the Portland cement industry, which has had a more recent origin, is rapidly assuming prominence. The Adirondack region supplies most of the crystalline graphite obtained in this country; its garnet has a wide reputation for abrasive purposes. The talc deposits of St Lawrence county are unique for size and quality of the material yielded; they furnish great quantities to paper manufacturers in the United States, besides supporting an important export trade. Ulster county is the principal source of millstones of American make. The salines and rock salt found in the western counties furnish about one third of the domestic salt production. The establishment of the soda industry within recent years has been due to the abundance of these deposits and the economy with which they can be exploited. Gypsum has been quarried in the central and western parts of the State for many years, but until lately the material was utilized almost solely for agricultural purposes. With the recognition of its adaptability to calcining, a new impetus has been given to quarrying activity and an increased output has ensued. All varieties of iron ore that are used in smelting occur in New York. The Adirondacks and the Hudson Highlands contain numerous

deposits of magnetite; the Clinton formation extending across the central and western counties carries hematite, which is also found in the crystalline strata of St Lawrence county; and the Hudson river region furnishes limonite and carbonate ores. Pyrite, a sulfid of iron employed for making sulfuric acid, is mined in St Lawrence county. The mineral springs of the State deserve mention for their varied character and economic importance. In addition to the revenue obtained from tourists and health seekers, the waters are shipped in large quantities to every part of the country. The absence of workable coal seams from the New York geologic series is noteworthy, inasmuch as the great coal fields of Pennsylvania begin but a few miles south of the state line. The other mineral fuels, gas and petroleum, are represented, the former being found over a wide area. Among the remaining mineral substances that are produced to a greater or less extent are feldspar, vein quartz, glass sand, infusorial earth, metallic paint, slate pigment, sienna, lead and zinc ore and carbon dioxid.

The accompanying table gives the mineral production of New York for the year 1904. The aggregate value of the products was \$27,766,905. There were approximately 10,000 workings (mines, quarries and wells) which contributed to the output. Although the conditions in some branches of the industry were not such as to encourage unusual activity on the part of the producers, the results exhibited by the returns indicate that on the whole substantial progress was made.

Among the notable features of the year's record was an increase of about 80,000 tons in iron ore production which was the largest since 1892. The outlook for continued growth of this industry seems encouraging. For the last few years the resources of the State have been exploited on a comparatively small scale owing to the fact that the ores of other districts were more favorably situated with regard to the principal markets and at the same time could be more cheaply mined. The consumption of iron, however, is increasing so rapidly in this country that the time can not be far distant when additional sources of ore supply must be drawn upon to a large extent. The Adirondack magnetite deposits undoubtedly have great potential value. By a simple concentration process, as now practised by the mining companies in this region, the ores can be brought to a standard above the average obtained in most districts; shipments ranging above 65 per cent in iron content are being made to Pennsylvania furnaces. Some of the mines yield low phosphorus ores that are much sought for by Bessemer steel manufacturers.

The clay-working industry has steadily gained in importance. The output during 1904 was valued at \$11,504,704, showing a large increase over the total for any previous year. Building materials (brick, tile, terra cotta and fireproofing) constituted the principal part of the production. The Hudson river district alone reported an output of brick valued at \$5,846,097. The manufacture of the finer grades of pottery, to which, hitherto, little attention has been given in this State, is becoming prominent. The porcelain wares (electric supplies and tableware) made in 1904 represented a value of nearly \$1,000,000.

The hydraulic cement industry was influenced adversely by the depressed state of the trade. Throughout the year the market for both Portland and natural rock cement ruled so low that there was little profit in their manufacture, and some companies preferred to close down their plants than to sell at the prevailing prices. The output of 3,258,932 barrels represented a reduction of about 25 per cent from the total for 1903.

The quarrying of building stone was also less active, due to the smaller demand for the material in the larger cities. The value of the stone products, exclusive of slate and limestone used in making cement, aggregated \$5,124,251. While the quarrying industry is extensive there is still room for expansion, particularly for the granites and marbles, the output of which represents a small proportion of the quantity used annually in the State.

In salt manufacture the high rate of production that has been maintained for the last few years was continued during 1904. The total of 8,724,768 barrels or 1,221,467 short tons, was rather above the average yield, although it was curtailed to some extent by the small output of the plants making solar salt which experienced an unusually poor season. A considerable proportion of the salt production was converted into soda.

The combined value of the petroleum and natural gas produced during the year was \$2,261,967. There were no unusual developments in the oil fields, and the output which amounted to 1,036,179 barrels was about the same as in 1903. The production of natural gas showed a moderate increase contributed mostly by wells in Erie county. At the average value reported of 23 cents per 1000 cubic feet the total quantity of natural gas produced was 2,399,987,000 cubic feet, approximately equivalent for heating purposes to 120,000 tons of coal.

Mineral waters with an output valued at \$1,600,000, ranked well up in the list of products. An important branch of the industry that has been developed in New York is the recovery of carbon

dioxid for use in carbonating artificial waters. The gas occurs abundantly at Saratoga Springs where several companies are engaged in its production. It is liquefied under pressure and stored in steel cylinders for transport to the consumers. The shipments in 1904 amounted approximately to 4,000,000 pounds valued at \$300,000.

Mineral production of New York in 1904

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement.....	Barrels.....	1 377 302	\$1 245 778
Natural rock cement.....	Barrels.....	1 881 630	1 207 883
Building brick.....	Thousands.....	1 293 538	7 473 122
Pottery.....	.....	.....	1 438 634
Other clay products.....	.....	.....	2 592 948
Crude clay.....	Short tons.....	8 959	17 164
Emery.....	Short tons.....	1 148	17 220
Feldspar and quartz.....	Long tons.....	8 703	28 463
Garnet.....	Short tons.....	3 045	104 325
Glass sand.....	Short tons.....	11 080	8 484
Graphite.....	Pounds.....	3 132 927	119 509
Gypsum.....	Short tons.....	151 455	424 975
Iron ore.....	Long tons.....	619 103	1 328 894
Millstones.....	.....	.....	21 476
Metallic paint.....	Short tons.....	4 740	55 768
Slate pigment.....	Short tons.....	3 132	23 876
Mineral waters.....	Gallons.....	8 000 000	1 600 000
Natural gas.....	1000 cubic feet.....	2 399 987	552 197
Petroleum.....	Barrels.....	1 036 179	1 709 770
Pyrite.....	Long tons.....	5 275	20 820
Salt.....	Barrels.....	8 724 768	2 102 748
Roofing slate.....	Squares.....	18 090	86 159
Slate manufactures.....	.....	.....	7 441
Granite.....	.....	.....	221 882
Limestone.....	.....	.....	2 058 405
Marble.....	.....	.....	478 771
Sandstone.....	.....	.....	1 896 697
Trap.....	.....	.....	468 496
Talc.....	Short tons.....	65 000	455 000
Total value.....	.....	.....	\$27 766 905

CEMENT

Hydraulic cement has been manufactured in New York for many years. Natural rock cement was made in Ulster county as early as 1826, the product having been used in the construction of the Delaware and Hudson canal. The waterlimes of central New York are said to have been discovered before 1820, but the industry was not firmly established here till later. In 1828 the first plant was erected at Rosendale, a locality that soon

gained wide prominence for the quality of its cement. By 1840 the production of Rosendale and vicinity amounted to 600,000 barrels annually, and for a long time the district has been the largest center of natural cement manufacture in this country. According to F. H. Lewis,¹ the output in 1897 was approximately 3,500,000 barrels or 42% of the total reported for the United States in that year. The natural rock of Erie county was first used in 1839 when a mill was built at Akron. In 1870 a plant was erected at Howes Cave, and in 1874 at Buffalo.

The manufacture of Portland cement has been a development of the last 25 years. Its growth at first was retarded, no doubt, by the natural cement industry which commanded an extensive market, but recently it has made rapid progress. Portland cement was manufactured in 1881 by the Wallkill Portland Cement Co. near South Rondout, the first plant (other than experimental) to be erected in the State. The Empire Portland Cement Co. began operations at Warner in 1886 and has been active almost continuously since that time. Among other localities which were early identified with the industry are Wayland, Glens Falls and Montezuma.

Crude materials adapted for cement manufacture are quite widely distributed in New York, and are found at various geologic horizons. In the Rosendale district the natural cement rock occurs in the Cayuga series. Its thickness at Rondout is over 30 feet. The rock is an impure magnesian limestone, containing 20% or more of silica and alumina and 15 to 25% of magnesia. In the central and western parts of the State, the cement beds are mostly of Salina age. At Buffalo and Akron they measure seven or eight feet thick.

For Portland cement the materials used include limestones, marls, clays and shale. At one or two localities, limestone has been found that can be ground and burned directly, yielding a "natural Portland" cement, but generally a mixture of two materials is necessary to secure the proper chemical composition. The greater number of plants in the State employ a mixture of limestone and clay. The limestones are from the Trenton, Helderberg and Tully formations, while the clays belong to the Quaternary. A single plant owned by the Cayuga Cement Co. of Ithaca, employs shale from the Hamilton series in place of clay. A mixture of Quaternary marls and clays is used by four companies.

The production of cement is carried on at present in 10 counties of the State: Columbia, Erie, Greene, Livingston, Onondaga,

¹ The Mineral Industry. 1898. v. 6.

Schoharie, Steuben, Tompkins, Ulster and Warren. Of these Onondaga county contains the largest number of plants, having seven in operation last year, besides two that were idle. Four companies produced cement in Erie county, three in Ulster county, two in Greene and Steuben, and one each in the remaining counties of the list. Erie and Onondaga counties make both Portland and natural cements, but most of their product is of the latter variety. In Ulster county only natural cement is made.

Production and trade in 1904

The total output of cement last year was 3,258,932 barrels, valued at \$2,453,661. Separated as to variety the total represents 1,377,302 barrels of Portland valued at \$1,245,778, and 1,881,630 barrels of natural rock cement valued at \$1,207,883. There were 23 companies in operation during the year. The following table shows the output distributed according to the localities in which it was made. Where the number of producers was less than three, the output has been combined with that of other localities so as not to reveal the figures of individual companies.

Production of cement in 1904

LOCALITY	PORTLAND CEMENT		NATURAL HYDRAULIC CEMENT	
	Barrels	Value	Barrels	Value
Erie county.....	.....	.....	332 781	\$149 112
Onondaga ".....	a	a	96 333	47 010
Ulster ".....	a	a	c 452 516	1 011 761
Greene ".....	b 617 575	\$545 782	.....	.....
Other localities.....	759 727	699 996	.....	.....
Total.....	1 377 302	\$1 245 778	1 881 630	\$1 207 883

a Included in other localities; b includes Columbia county; c includes Schoharie county.

The output of Portland cement which was reported by 10 companies (one company produced both Portland and natural rock cement) was somewhat smaller than in 1903. The decrease may be traced to the unfavorable state of the market, as there was no falling off in the capacity of the works. Throughout the entire year the prices for both Portland and natural rock cements ruled so low that there was little profit for manufacturers. In fact, some of the companies preferred to close down their plants rather than to sell their product at the current quotations, and others

operated on a reduced scale. The depressed condition of the trade was due to the largely increased output of the previous year in nearly every section of the country. Owing to a temporary decline in the demand, which recently has grown very rapidly, many of the companies entered on the year with large stocks, causing an oversupply that could not be disposed of except at reduced prices. With the removal of this surplus from the market, it is expected that the prices will reach a more normal level when the manufacture can be profitably continued.

The quantity of natural rock cement reported represents a decline of nearly one third from that of the previous year. The decrease was most noticeable in the Rosendale district, but it was also distributed among the other works. There were 14 companies engaged in this branch of the industry.

The list of cement producers in 1904 is as follows:

Portland cement

NAME	LOCATION OF OFFICE
Alsen's American Portland Cement Works	Alsen
Catskill Cement Co.	Smith's Landing
Cayuga Lake Cement Co.	Ithaca
Empire Portland Cement Co.	Warner
Glens Falls Portland Cement Co.	Glens Falls
Helderberg Portland Cement Co.	Albany
Hudson Portland Cement Co.	Hudson
Iroquois Portland Cement Co.	Caledonia
Thomas Millen Co.	Wayland
Wayland Portland Cement Co.	Wayland

Natural rock cement

NAME	LOCATION OF OFFICE
Akron Cement Works	Buffalo
E. B. Alvord Co.	Jamesville
Bangs & Gaynor	Fayetteville
James Behan Cement Works	Manlius
Consolidated Rosendale Cement Co.	Rondout
Cummings Cement Co.	Akron
Buffalo Cement Co.	Buffalo
Helderberg Portland Cement Co.	Albany
H. L. & W. C. Newman	Akron
Newark Lime & Cement Manufacturing Co.	New York city
New York Cement Co.	Rosendale
Potter-Brown Cement Works	Manlius
Thomas W. Sheedy	Fayetteville
Spencer & McCarthy	Jamesville

The Cummings Cement Co., which is listed among the manufacturers of natural rock cement, has been a producer also of Portland cement though it made no output of that material last year. The Helderberg Portland Cement Co. produces both kinds. The firm of Spencer & McCarthy was succeeded on April 1, 1904, by the Jamesville Milling Co. The Empire, Hudson and Glens Falls Portland cement plants were operated for a part of the year only.

CLAY

The manufacture of brick and other clay products is the most important branch of the mineral industry in New York. Clay deposits suitable for making the common wares are distributed throughout every section in practically inexhaustible quantities. The rapidly growing market for these products has led to the establishment of numerous manufacturing plants in recent years, so that now there is scarcely an industrial center of any size in which they are not produced. This is particularly true with regard to the manufacture of building materials, which are being employed more and more widely as an element in permanent construction. Owing to their cheapness, durability and the convenience with which they can be adapted to meet the varied architectural requirements, the use of these materials will doubtless continue to expand for a long time to come.

The manufacture of the finer grades of clay wares has not developed so rapidly as the other lines. In contrast with most of the states along the Atlantic seaboard, New York possesses almost no deposits of kaolin in quantity to be of economic value. This fact has retarded, hitherto, the establishment of industries in which kaolin is employed, but, with improved facilities of transport, the deficiency has become less formidable to local manufacturers. There are now several plants in the State making tableware, electrical supplies and other porcelain and semiporcelain wares.

The distribution of clays in New York as well as their character, uses and industrial development has been exhaustively described in a report by Heinrich Ries¹, to which the reader is referred for fuller details. The most valuable deposits now under exploitation are those situated along the Hudson valley. They are particularly adapted for the manufacture of brick, of which great numbers are consumed in New York city. According to Dr Ries, the deposits belong to two types: (1) estuary deposits of strati-

¹N. Y. State Mus. Bul. 35. 1900.

fied sand, blue and yellow clay, and (2) cross-bedded delta deposits composed of much coarser materials than those of the first class. The clays are normally blue, but commonly show weathering on the surface when they change to yellow. With the alternating layers of sand, they form terraces that extend along either shore of the river at altitudes ranging up to over 300 feet. The workable beds attain a thickness of 100 feet or more. Some of the more prominent localities where these clays are utilized for brickmaking are Haverstraw, Croton, Stony Point, Verplanck, Peekskill, Cornwall, New Windsor, Dutchess Junction, Fishkill, Roseton, Poughkeepsie, Kingston, Saugerties, Catskill, Hudson and Albany. The product of this region is confined to the common grades of building brick.

The northern and central portions of Long Island contain Cretaceous clays, some of which are adapted for stoneware and coarser pottery. Brick clays occur abundantly, and are worked at Garden City, East Williston, Farmingdale, Port Jefferson, Southold and Greenport. The manufacture of pottery is carried on by several firms in Brooklyn, but most of the materials used in the better wares are derived from without the State.

The clays of Staten Island are important and of varied quality. Some of the purer grades approach kaolin in composition and have a white color. They have been employed largely in making terra cotta. A plant for the manufacture of this material is located at Tottenville. Fire brick and pressed brick are produced at Kreischerville and common brick at Green Ridge.

In the interior of the State clay deposits are quite uniformly distributed, but their economic utilization is confined mostly to the vicinity of the larger towns. They are nearly all of glacial origin, though more or less modified by sedimentary processes. They occur in basin-shaped beds that range up to 50 feet or more in thickness. In the western counties the principal centers of clay working are Rochester and Buffalo, both cities drawing their supplies of building brick from local plants. The manufacture of pottery, building tile, fire brick, sewer pipe and draitile is also carried on here. Roofing tile of excellent quality is made at Alfred, Allegany Co. The largest potteries in the State are located at Syracuse; their products include earthenware, china and electrical supplies. Besides common brick, for which an extensive local market exists, the city is an important producer of paving brick.

Along the Mohawk valley the clay deposits are exploited for building brick, while at Troy considerable quantities of fire brick and stove lining are also made.

Throughout the central and southern counties of the State, the Devonian strata covering this section include frequent beds of shale, much of which is quite argillaceous and can be used for the same purposes as clay. Up to the present time they have been little developed, though their value has been satisfactorily demonstrated by the results obtained in their practical application. Among the products that have been made from this material are building and paving brick, terra cotta, roofing tile, fireproofing and sewer pipe.

Production of clay materials

The statistics set forth in the following pages have been compiled from returns made by the various producers of clay materials for the year 1904. It is believed that they are complete and accurate, as reports have been received from nearly every manufacturer in the State.

The total value of the various clay materials manufactured in New York last year amounted to \$11,504,704. This total is undoubtedly a record one, largely exceeding that of any previous year. It represents the combined output of 245 plants scattered over 43 counties of the State. More than one half of the product in value consisted of common building brick, which aggregated \$7,234,876. Front brick and fancy building brick accounted for only \$238,246 of the total, and vitrified paving brick for \$210,707; both being exceeded by the output of fire brick and stoveling, which was valued at \$506,800. The manufacture of draintile reached a total of \$149,864, and sewer pipe a total of \$460,000. The product of terra cotta was valued at \$798,028; fireproofing at \$157,119, and building tile at \$206,503. In addition there were produced miscellaneous products, including flue lining, fire tile and shapes, conduit pipes, sidewalk brick and acid-proof brick, the collected value of which was \$103,927. The potteries of the State reported an output valued at \$1,438,634.

Production of clay materials in 1904

Material	Number	Value
Common brick.....	1 275 859 000	\$7 234 876
Front brick.....	17 679 000	238 246
Vitrified paving brick.....	16 351 000	210 707
Fire brick and stove lining.....		506 800
Drain tile.....		149 864
Sewer pipe.....		460 000
Terra cotta.....		798 028
Fireproofing.....		157 119
Building tile.....		206 503
Miscellaneous.....		103 927
Pottery.....		1 438 634
Total.....		\$11 504 704

The distribution of the products according to counties shows that Rockland county has the most extensive clay-working industry. The value of its output last year was \$1,422,436, reported by 34 plants. Its importance is due to the extensive manufacture of common building brick, which are supplied to the New York city market. This statement may be applied also to Ulster county, which ranks second with a total of \$1,274,284, and to Dutchess county, which is third with a total of \$932,907. On the other hand, Onondaga county standing fourth in the list, with an output valued at \$916,954, is chiefly represented by pottery, while brickmaking is very subordinate. The other counties that reported a production of over \$500,000 in value are Orange (\$690,064), Monroe (\$658,058), Albany (\$648,973), Erie (\$647,334) and Kings county (\$539,288). The following table shows the value of all kinds of clay products made in the different counties of the State.

Production of clay materials by counties

County	Total value	County	Total value
Albany.....	\$648 973	Fulton	4 000
Allegany.....	127 552	Greene	232 924
Broome.....	22 000	Jefferson	30 467
Cayuga.....	24 520	Kings.....	539 288
Chautauqua.....	83 405	Madison.....	16 400
Chemung.....	96 300	Monroe.....	658 058
Clinton.....	5 000	Nassau.....	52 644
Columbia.....	420 500	Niagara.....	16 892
Dutchess.....	932 907	Oneida.....	145 880
Erie.....	647 334	Onondaga.....	916 954

Production of clay materials by counties (concluded)

County	Total value	County	Total value
Ontario.....	\$245 743	Steuben.....	\$176 613
Orange.....	690 064	Suffolk.....	86 112
Rensselaer.....	257 751	Tompkins.....	17 715
Richmond.....	488 873	Ulster.....	1 274 284
Rockland.....	1 422 436	Washington.....	15 755
Saratoga.....	331 360	Westchester.....	354 705
Seneca.....	19 175	Other counties a. a. .	502 120
		Total.....	\$11 504 704

a Includes the following: Genesee, Lewis, Montgomery, New York, Queens, St Lawrence, Schenectady, Warren, Wayne and Wyoming.

The manufacture of building brick

The total number of common and front brick used for building purposes made in 1904, amounted to 1,293,538,000 valued at \$7,473,122. Of this quantity, 1,275,859,000 valued at \$7,234,876 were common brick, and 17,679,000 valued at \$238,246 were front brick. The manufacture of these materials was carried on in 37 counties, with a total of 187 plants. The average price received for common brick throughout the State was \$5.67 a thousand, and for front brick \$13.48 a thousand. For common brick the prices ranged from \$8 a thousand, the average reported by plants in Steuben county, to \$4, the average for Montgomery county.

Production of building brick in 1904

COUNTY	COMMON BRICK		FRONT BRICK	
	Number	Value	Number	Value
Albany.....	78 500 000	\$462 973	.....	.....
Allegany.....	1 516 000	9 098	.....	.....
Broome.....	4 000 000	22 000	.....	.....
Cayuga.....	3 320 000	20 920	.....	.....
Chautauqua.....	6 619 000	39 539	.....	.....
Chemung.....	15 500 000	95 000	.....	.....
Clinton.....	1 000 000	5 000	.....	.....
Columbia.....	73 280 000	420 500	.....	.....
Dutchess.....	167 299 000	932 707	20 000	\$200
Erie.....	62 286 000	292 448	3 750 000	32 250
Greene.....	38 051 000	232 924	.....	.....
Jefferson.....	4 577 000	30 467	.....	.....
Madison.....	400 000	2 400	.....	.....

Production of building brick in 1904 (*concluded*)

COUNTY	COMMON BRICK		FRONT BRICK	
	Number	Value	Number	Value
Monroe.....	22 394 000	\$129 030	.....	.....
Nassau.....	7 600 000	47 644	.....	.....
Niagara.....	2 852 000	16 892	.....	.....
Oneida.....	18 880 000	85 880	.....	.....
Onondaga.....	20 750 000	120 017	500 000	\$5 000
Ontario.....	2 618 000	15 738	7 100 000	77 900
Orange.....	121 803 000	690 064	.....	.....
Rensselaer.....	17 232 000	85 964	.....	.....
Richmond.....	.....	.....	2 809 000	86 146
Rockland.....	239 813 000	1 422 436	.....	.....
St Lawrence.....	600 000	3 000	.....	.....
Saratoga.....	58 070 000	284 561	.....	.....
Seneca.....	2 025 000	10 175	.....	.....
Steuben.....	4 485 000	35 858	.....	.....
Suffolk.....	15 050 000	83 112	.....	.....
Tompkins.....	2 720 000	16 340	.....	.....
Ulster.....	219 106 000	1 274 284	.....	.....
Warren.....	5 724 000	28 625	.....	.....
Washington.....	1 275 000	7 000	.....	.....
Westchester.....	51 234 000	287 295	3 500 000	36 750
Other counties <i>a</i> ..	5 280 000	24 979	.....	.....
Total.....	1 275 859 000	\$7 234 876	17 679 000	\$238 246

a Includes Fulton, Lewis, Montgomery and Wayne counties.

Hudson river region. The counties along the Hudson river are the largest producers of building brick in the State. Owing to the extensive market afforded by New York city and the low costs of transport by river, the industry in this section is exceptionally situated so far as commercial conditions are concerned. There is probably no other region in the world where the manufacture of brick has attained to similar proportions. The counties included in this region are Rensselaer, Albany, Columbia, Greene, Ulster, Dutchess, Orange, Rockland and Westchester. With the exception of Albany and Rensselaer, which probably consume the greater part of the local product, their output is marketed almost entirely in New York city.

During 1904 the number of brick made was 1,009,838,000, valued at \$5,846,097. This total represents about 78% of the whole product of the State. There were 110 companies reporting as active, of which Rockland county was represented by the largest number, 34, while Ulster was second on the list, with 21, and Dutchess third, with 17. The average number of brick made

in each plant was 9,180,000. The price reported for the whole district averaged \$5.79 per thousand. Two companies, Ryan & McFarren of New Windsor, and Coyne & Tanney of Haverstraw, reported an output for the first time in 1904.

Output of brick in the Hudson river region

County	Number of plants	Output	Value	Average price per M.
Albany.....	8	78 500 000	\$462 973	\$5 90
Columbia.....	4	73 280 000	420 500	5 74
Dutchess.....	17	167 319 000	932 907	5 58
Greene.....	4	38 051 000	232 924	6 12
Orange.....	9	121 803 000	690 064	5 67
Rensselaer.....	6	17 232 000	85 964	4 98
Rockland.....	34	239 813 000	1 422 436	5 93
Ulster.....	21	219 106 000	1 274 284	5 82
Westchester.....	7	54 734 000	324 045	5 92
Total.....	110	1 009 838 000	\$5 846 097	\$5 79

Other clay materials

The manufacture of paving brick was carried on in Chautauqua, Onondaga, Rensselaer, Saratoga, Steuben and Tompkins counties. There were eight companies engaged in the business, and the number of brick made was 16,351,000, valued at \$210,707.

Fire brick and stove lining were manufactured in Albany, Chautauqua, Erie, Kings, Monroe, Oneida, Rensselaer, Richmond, Steuben and Westchester counties. The value of the output amounted to \$506,800, reported by 14 companies.

Draintile and sewer pipe were manufactured by 27 companies located in Allegany, Cayuga, Chautauqua, Chemung, Erie, Genesee, Kings, Madison, Monroe, Onondaga, Ontario, Saratoga, Seneca, Steuben and Tompkins counties. The draintile output was valued at \$149,864, and that of sewer pipe at \$460,000.

Terra cotta, fireproofing and building tile were produced in Albany, Allegany, Erie, Genesee, Kings, Monroe, New York, Onondaga, Queens, Rensselaer, Richmond and Steuben counties, by a total of 16 companies. The value of the production was: terra cotta, \$798,028; fireproofing, \$157,119; building tile, \$206,503.

Pottery

The grades of pottery made in New York range from common earthenware to porcelain. Formerly there was little of the finer

wares produced in the State, due undoubtedly to the lack of suitable raw materials. This disadvantage is offset, to some extent at least, by better market facilities than can be had in most sections of the country, and with low transport rates local manufacturers are not seriously handicapped in the competition for trade. The industry is still a small one, but it seems to be placed on a permanent basis.

The following table shows the production of the various articles of pottery for 1904. In case the output of any particular ware was reported by only one or two producers, it has been grouped with that of other wares, so as not to reveal the individual figure.

Production of pottery in 1904

Ware	Number of producers	Value of product
Stoneware.....	5	\$77 726
Red earthenware.....	7	44 990
Porcelain and semiporcelain ^a	3	740 000
Electric and sanitary supplies.....	6	400 095
Miscellaneous.....	9	85 823
Total.....	30	\$1 438 634

^a Includes china tableware.

The miscellaneous products not separately enumerated include yellow and rockingham wares, clay tobacco pipes, fire clay crucibles and artistic pottery.

Altogether 12 counties participated in the production which was reported by 22 companies. Onondaga county was the largest manufacturer of pottery, its output for the year being valued at \$673,590. Kings county ranked second with an output valued at \$279,009, and Erie third with \$200,300. The remaining counties reporting a production were Albany, Madison, Ontario, Monroe, Nassau, Oneida, Schenectady, Suffolk and Washington. The list of manufacturers includes the following:

NAME	LOCATION OF OFFICE	PRODUCT
Albany City Pottery	Albany	Red earthenware
Henry Betz & Bros.	Buffalo	Red earthenware
Buffalo Pottery Co.	Buffalo	Semiporcelain
Charles Kurth	Ridgewood L. I.	Tobacco pipes
Empire China Works	Brooklyn	Electric supplies

Charles Graham Chemical Pottery Works	Brooklyn	Stoneware and sanitary ware
Greenpoint Pottery	Brooklyn	Stoneware
Gottlieb Umbach	Brooklyn	Cooking ware
Union Porcelain Works	Brooklyn	Stoneware and red earthenware
Central New York Pottery Co.	Chittenango	Yellow ware
John Schmidt	Rochester	Stoneware and red earthenware
John B. Benkert	Corona	Stoneware and red earthenware
White's Pottery Inc.	Utica	Flemish stoneware
Onondaga Pottery Co.	Syracuse	China ware
Pass & Seymour Inc.	Syracuse	Electric supplies
Edward Reagan	Syracuse	Tobacco pipes
Syracuse Pottery Co.	Syracuse	Red earthenware
George Zimmerman	Belle Isle	Red earthenware
Locke Insulator Mfg. Co.	Victor	Electric supplies
Bellevue Porcelain Works	Schenectady	Electric supplies and crucibles
T. A. Brouwer jr	Westhampton	Art pottery
Hilfing Bros.	Fort Edward	Stoneware and red earthenware

Crude clay

In the foregoing tables relating to clay products, no account has been taken of the quantity of clay entering into their manufacture. There are a few producers in the State, however, who do not utilize the crude clay themselves, but ship it to plants in other localities. Some of the material, like the Albany slip clay, is even forwarded to points without the State. For 1904 returns have been received from eight firms engaged in this industry whose total shipments amounted to 8959 tons, valued at \$17,164. Of this quantity 3228 tons valued at \$9630 consisted of slip clay and the remainder of common clay, fire clay and kaolin.

EMERY

Deposits of emery are found in Westchester county, southeast of Peekskill. The mines, which were first opened for iron ore, occur along the contact of basic igneous intrusions belonging to the gabbro series. They are mostly shallow, and ordinary quarrying methods are employed in extracting the material.

The emery is composed of corundum, magnetite, spinel and garnet in varying proportions. The product is ground and made into wheels, for which purpose it is said to give good satisfaction, though inferior to imported emery.

The production of emery in 1904 amounted to 1148 short tons, valued at \$17,220, which was less than in the previous year. There were four concerns engaged in active mining: the Blue Corundum Co. of Boston Mass., the Tanite Co. of Stroudsburg Pa., H. M. Quinn of Philadelphia Pa., and J. R. Lancaster of Peekskill. The Hampden Corundum Wheel Co. of Springfield Mass., made no output last year.

FELDSPAR AND QUARTZ

Feldspar suitable for pottery purposes is obtained near Bedford, Westchester co. It occurs in the pegmatite dikes intersecting the crystalline rocks of that region and is associated with quartz, mica and tourmalin. In some of the dikes the feldspar forms large masses or crystals, quite free from impurities, while in others it is intergrown with quartz; only the former occurrences, however, have commercial value. The feldspar belongs to the variety known as orthoclase, which is characterized by a high potash content. It varies from dark red to white in color. The chemical composition is shown by the following analysis: SiO_2 , 65.85%; Al_2O_3 , 19.32%; Fe_2O_3 , .24%; K_2O and Na_2O , 14.1%; CaO , .56%; MgO , .08%. The Bedford quarries have been worked since 1878. At present the only producer is P. H. Kinkel & Son. The output is shipped mostly to pottery manufacturers at Trenton N. J. A feldspar quarry opened near Ticonderoga in 1900 was active for a time. The deposit is said to range from 10 to 40 feet in width and to carry 75% feldspar; 20% quartz and 5 % mica.

Vein quartz is produced near Bedford for pottery use and the manufacture of wood filler and silicate paint. Its occurrence is similar to that of the feldspar already described. The largest producer is the Bridgeport Wood Finishing Co. of New Milford Ct.

GARNET

The production of garnet for abrasive uses is a well established industry in the Adirondack region. The excellence of the product from a commercial standpoint and the relatively large yield obtained from the rocks of this section combine to give the quarries a material advantage over other localities where garnet has been worked.

The Adirondack garnet belongs to the common or almandin variety. It is found associated with hornblende-feldspar rocks as crystals that range from small size up to masses measuring several feet across. The rocks show great variation in the quantity of garnet present, but only the best or richest portions are exploited. The general procedure consists in breaking down the rock, crushing sufficiently fine to release the garnet, and washing. In many cases the crystals have been so shattered by dynamic forces that they readily part from the accompanying rock after blasting. Some difficulty is experienced in the separation of the garnet mechanically owing to the fact that its specific gravity is but little greater than that of the accompanying hornblende. A special form of concentrator introduced by the North Creek Garnet Co. has solved this difficulty very successfully. A product is made which carries less than 5% impurities.

The Adirondack quarries are situated in the Hudson river valley near the Essex-Warren county boundary. North Creek is the principal point of shipment. The largest operators in recent years have been the North River Garnet Co., owning quarries a short distance west of North River, and H. H. Barton & Son, with properties on Gore mountain, a prominent peak southwest of North Creek. Other concerns have been active at various times, but their output has been small and intermittent.

The production of New York garnet in 1904 amounted to 3045 short tons valued at \$104,325, about the same quantity as in the previous year. The average value of the product was \$34.25 a short ton. The chief demand for garnet is in the wood-working and leather industries.

The North River Garnet Co. has a mill under course of erection on Thirteenth lake, a few miles southwest of the present plant. The latter will be dismantled and operations confined to the new locality as soon as the equipment can be installed.

GLASS SAND AND MOLDING SAND

Deposits of sand suitable for building and constructive purposes occur in almost every section of the State. No attempt has been made to canvass the industry owing to the difficulties which would attend such an investigation. The value of the material, as a rule, is little more than the cost of excavation and transport to market.

Glass sand is found in great abundance on the shores of Oneida lake and contiguous territory. The principal workings have been in the towns of Rome, Verona, Vienna, Oneida co. and Constantia,

Oswego co. The deposits vary from 6 inches to 3 feet in thickness and are covered by a few inches of soil. After sieving and washing the sand is ready for market. It is consumed in the manufacture of window glass, and common glassware, and nearly all of the product goes to points within the State, principally to Rochester, Ithaca, Lockport, Black Rock, Syracuse and Clyde. An analysis of the sand from West Vienna furnished by B. Delahunt, manager of the Oneida Lake Sand Mine, shows its composition to be as follows: SiO_2 , 98.6%; Fe_2O_3 , .23%; Al_2O_3 , .17%; MgO , trace.

There were only three producers that reported an output in 1904: F. L. Marsden & Co., Bernhard's Bay; J. L. Bentley, Fish Creek; and the Oneida Lake Sand Mine, Cleveland. The total shown by their reports was 11,080 short tons, valued at \$8484. According to statistics collected by Prof. C. H. Smyth jr, the output in 1902 was approximately 8700 tons.

Molding sand of excellent quality is supplied from the Hudson river valley. In Albany county, at Delmar and Selkirk, there are large deposits which yield the finest grade of sand for the manufacture of stove and other castings that require a smooth finish. In a recent paper by F. J. H. Merrill¹, it is stated that Albany sand is considered so superior for fine work that shipments are made to distant points at an expense of nearly \$3 a ton for freight. Deposits are also worked near Cocksackie station in Columbia county and near Camelot and New Hamburg in Dutchess county. The molding sand forms a stratum from 10 inches to 3 feet thick underlying the surface soil. The owner of the land receives on the average about \$2.50 an acre as royalty for removing the deposit. It is said that after an interval of years a second stratum of molding sand may be taken from land that has previously been worked.

A refractory sand known as fire sand is used in foundries for making cores. This material is supplied to some extent from the Oneida lake deposits. The output reported in 1904 was 4000 tons, valued at \$1200.

GRAPHITE

Graphite is widely distributed through the metamorphic rocks of the Adirondacks, but so far active mining operations have been confined to a few localities. The most productive region is in the vicinity of Lake George, in Warren and Washington counties. Deposits of crystalline graphite have been exploited here for a long time and they continue to yield the greater part of the high grade material produced in this country.

¹Eng. & Min. Jour., Sep. 1, 1904. P. 341.

The graphite occurs in small veins and dikes intersecting the metamorphic strata and in the form of thin crystals or scales disseminated through quartzites, schists and limestones. The veins are perhaps the richest of all the deposits, though they rarely, if ever, occur in sufficient size to be valuable. The graphite is found in leaves and larger masses, more or less admixed with quartz but otherwise free from impurities. These deposits bear some resemblance to the dikes, which also yield a coarsely crystalline product associated with feldspar, quartz and other minerals common to pegmatite. The only successful attempt at working a dike has been at Chilson hill near Ticonderoga, where operations were carried on for several years by the Joseph Dixon Crucible Co. As a rule there is little regularity in the occurrence of pegmatite deposits, and this fact detracts from their value as mining propositions.

The graphitic quartzites, schists and limestones, while not so rich as the veins and dikes, are more persistent and can be worked on a larger scale. At present they are the basis of all active operations in the State. The graphite occurs in finely divided particles disseminated throughout the rock mass; its recovery is a matter of some difficulty, since the rock must be broken down to such a size that the graphite is released and then subjected to concentration the reverse of the process usually followed in separating ores from gangue. The difficulty is greatly increased if the graphite is accompanied by other scaly minerals like those of the mica group.

The most successful graphite mine in the Adirondacks is that worked by the Joseph Dixon Crucible Co., in the town of Hague, five miles west of Lake George. The deposit consists of a bedded quartzite associated with the schists and gneisses of that region. It is of great extent and for several years has supplied almost the entire product of the State. The company operates two mills for the separation and refining of the graphite, one situated at the mine and the other at Hague. A feature of the concentration process at the latter place is the use of the Hooper air jig which has been found to be well adapted for treating graphitic rocks of this character.

Aside from the operations of this company there was little graphite produced in New York during 1904. The mine and works of the Adirondack Mining & Milling Co. on South bay near Dresden, were inoperative for most of the year, as were those owned by the Ticonderoga Graphite Co. The latter concern has been taken over by the Columbia Graphite Co. of Pittsburg Pa. The mines are situated near Rock pond between Ticonderoga and Schroon where there is a

mill equipped with stamps and buddles. In character the deposit resembles the graphitic quartzite of Hague, but it is of larger size and somewhat lower in grade.

A new undertaking is the Champlain Graphite Co., which was organized late in the year to develop a deposit of graphitic schist near Whitehall. A mill is now under course of construction. The Silver Leaf Graphite Co. of the same place did not engage in productive operations during the year.

Some attempts to mine graphite have been made on the opposite side of the Adirondacks in St Lawrence county. Both veins and disseminated deposits occur in association with crystalline schists. Some development work was done last year on a prospect near Pope Mills, town of Macomb. The graphite occurs as fine scales in schist and the deposit is said to be extensive. About 500 tons of rock have been taken out and a mill has recently been completed.

The production of crystalline graphite from New York mines in 1904 was 3,132,927 pounds, valued at \$119,509. There was little change in the output compared with previous years.

The International Acheson Graphite Co. of Niagara Falls reported a production of 3,248,000 pounds of artificial graphite, valued at \$217,790.

GYPSUM

The gypsum quarried in New York is the rock or massive variety. It occurs as interbedded deposits in the shales and limestones of the Salina stage. Seams of selenite, the crystallized variety, sometimes accompany the deposits, but they are so limited as to have little economic value. The rock gypsum usually contains clay, carbonates, silica and other impurities, the presence of which in appreciable quantities is injurious to its use for some purposes. Till recently most of the gypsum obtained in the State was ground and sold as land plaster. It has been found, however, that the better quality of rock can be utilized in manufacturing wall plaster, and several companies have engaged in this industry which now consumes the greater part of the quarry output.

The main gypsum beds outcrop near the southern edge of the area occupied by the Salina strata. The latter have a quite uniform dip to the south. Smaller deposits occurring in the lower horizons of the Salina are not worked. The number of beds in any given locality varies, but usually two at least have been found. In order to facilitate operations, the workings are located near the outcrop of the deposits, where there is the least overburden. No

effort has been made to carry on exploitation at any considerable depth, and in most cases ordinary quarrying methods are employed for extracting the rock. The edges of low hills are considered favorable points for opening new deposits. After the beds have been followed back into the hill for some distance, if the overlying strata are heavy, the work may be continued under cover as in mining.

The gypsum when first extracted is gray or drab in color, becoming lighter on exposure. Organic matter seems to be the principal coloring agent. The presence of iron oxids gives a brownish tint to the rock which can not be removed by calcination.

Quarries have been opened at frequent intervals along the outcrop of the Salina formation. The most easterly points where gypsum is produced are in Madison county, near Cotton and Hobokenville. The output in this region is small and is used locally for land plaster. In Onondaga county there are quarries at Fayetteville, Manlius Centre, Marcellus and Half Way, those at Fayetteville being most important. At the latter locality the gypsum attains a maximum thickness of 60 feet, made up of several beds ranging from 18 inches to 30 feet each. The output is used in part for land plaster; the greater quantity, however, is calcined either by the local cement plants or by the wall plaster manufacturers that have works in Syracuse. At Union Springs, Cayuga co., a large quarry has been operated for a number of years, the first opening having been made in 1828. The deposits in Ontario county near Port Gibson and Victor are not worked at present. They have produced mostly land plaster. In Monroe county the town of Wheatland is an important center of the industry. The product goes to mills located at Garbuttsville and Wheatland which make land plaster, plaster of paris and wall plaster. Still farther west in Genesee county, gypsum is quarried extensively at Oakfield where large plaster works have been built. The deposit is not so thick here as in the eastern localities, but owing to its lighter color it is better adapted for calcination. In Erie county, the quarries at Akron have been intermittently active, supplying agricultural plaster to the local markets.

The development of the gypsum industry in New York, both present and future, depends altogether on the demand for the different products, since the crude rock exists in almost unlimited quantities. Its progress recently has been promoted by the establishment of plants for making stucco and wall plaster. The latter is perhaps the most important application, and the one that has

greatest possibilities for continual expansion. The consumption of land plaster has remained comparatively steady from year to year, with slight tendency to growth. The gypsum quarries are well situated for marketing the product, as most of them are on or near the Erie canal and the main railway lines.

Production in 1904. The output of gypsum last year amounted to 151,455 short tons. There were 16 companies engaged in quarrying the material, of which number seven were in Onondaga county, three each in Madison and Monroe counties, two in Genesee county and one in Cayuga county. The value of the output was \$424,975. The reports from the different companies show that the greater part of the gypsum produced was converted into wall plaster and plaster of paris, the total product of which was 88,255 tons, valued at \$347,885. Of the remainder 33,712 tons, valued at \$62,438, was ground for land plaster, and 9,768 tons, valued at \$14,652, was sold in the crude state. The production was made by the following companies.

NAME	LOCATION OF OFFICE
Cayuga Plaster Co.	Union Springs
Oakfield Plaster Manufacturing Co.	Buffalo
United States Gypsum Co.	Chicago Ill.
J. Mason jr	Clockville
F. A. Miller	Clockville
W. H. Osborn & Co.	Valley Mills
Consolidated Wheatland Plaster Co.	Caledonia
Garbutt Gypsum Co.	Garbutt
Lycoming Calcining Co.	Williamsport Pa.
James Behan Estate	Manlius
H. Lansing	Fayetteville
Spencer & McCarthy	Jamesville
National Wall Plaster Co. of America	Syracuse
F. M. Severance	Fayetteville
T. W. Sheedy	Fayetteville
William Valentine jr	Jamesville

IRON ORE

While there were no developments of unusual moment in iron mining last year, the record made by the various companies has been one of substantial progress. The total production of all classes of ore in the State amounted to 619,103 long tons, valued at \$1,328,894. In 1903 the output was 540,460 long tons, valued at \$1,209,899, showing an increase for the year of 78,643 tons, or approximately 15%.

Throughout the greater part of 1904 a general depression prevailed in the iron trade, which was naturally reflected in a decreased demand for ore. That the mining companies were able to maintain operations on a larger scale than in the previous year, despite the unfavorable conditions, must be regarded as creditable to the stability of the industry in this State. Consideration should be given also to the fact that most of the ore has to be sold on the open market, whereas in many districts of the country the mines are operated in connection with blast furnaces which furnish a steady outlet for their product.

The prospects for the future of iron mining in New York seem encouraging. The high grade magnetic ore produced by the Lake Champlain mines will doubtless continue to be in demand by furnaces so situated that the transport charges are not excessive. At the largest mines in this section, owned by Witherbee, Sherman & Co., a new magnetic separating plant has been installed which has materially augmented the scope of operations. It is probable that improvements of similar character will be undertaken elsewhere in the Adirondacks. Plans have been considered for the reopening of the mines near Fort Montgomery, Orange co. The mines are controlled by the Hudson Iron Co. of New York city, which has recently acquired properties in the vicinity of Gouverneur, St Lawrence co., with a view of commencing operations there during the present season.

The returns for 1904 show that the ore was distributed according to the usual classification as follows: magnetite 559,575 tons, valued at \$1,215,415; hematite 54,128 tons, valued at \$98,479; and limonite 5000 tons, at nominal valuation. Nearly all of the magnetite came from the Lake Champlain district, and was contributed by the mines at Mineville, Essex co., and at Arnold Hill and Lyon Mountain, Clinton co. Outside of this district the only magnetite produced was at Salisbury, Herkimer co. The magnetite was shipped for the most part in the form of concentrates. The hematite was contributed by three mines located at Furnaceville, Wayne co.; Spragueville, St Lawrence co.; and at Clinton, Oneida co. The limonite came from one mine at Amenia, Dutchess co. In all there were nine companies reporting as active.

The following table gives the production of the various kinds of iron ore in New York State during the last 10 years. The figures for 1903 and preceding years have been taken from the reports of John Birkinbine published in the annual volumes of the *Mineral Resources*.

Production of iron ore in New York State

YEAR	MAGNETITE	HEMATITE	LIMONITE	CARBONATE	TOTAL	Total value	Value per ton
	Long tons	Long tons	Long tons	Long tons	Long tons		
1895	260 139	6 760	26 462	13 886	307 256	\$598 313	\$1 95
1896	346 015	10 780	12 288	16 385	385 477	780 932	2 03
1897	296 722	7 664	20 059	11 280	335 725	642 838	1 91
1898	155 551	6 400	14 000	4 000	179 951	350 990	1 95
1899	344 159	45 503	31 975	22 153	443 790	1 241 085	2 80
1900	345 714	44 467	44 891	6 413	441 485	1 103 817	2 50
1901	320 467	66 380	23 362	1 000	420 218	1 006 231	2 39
1902	451 570	91 075	12 676	Nil	555 321	1 362 987	2 45
1903	451 481	83 820	5 159	Nil	540 460	1 209 890	2 24
1904	559 575	54 128	5 000	Nil	619 103	1 328 894	2 15

The statistics indicate a gradual though not a constant increase for the period given. As might be expected, the increase has not been manifest in the low grade limonite and carbonate ores, but has been due almost entirely to the growth of magnetite mining. No carbonate ore has been worked during the last three years, and the production of limonite is not important.

Developments at Mineville. The Mineville ore bodies have been exploited actively by the two companies operating in that locality Witherbee, Sherman & Co. and the Port Henry Iron Ore Co. The total shipments for 1904 amounted to over 400,000 tons, all high grade magnetite. The deposits worked by the former company are known as the Old Bed, New Bed and Harmony. The first is very phosphatic, while the New Bed runs quite low in phosphorus and the Harmony averages between the two extremes. The principal openings are the Joker, Bonanza and A and B shafts, of which the last two were recently sunk on the Harmony. The Cook shaft lies some distance from the others, and the relations of this ore body have not been definitely established. The operations of the Port Henry Iron Ore Co. were confined, as heretofore, to Mine 21 on the Old Bed.

The progressive policy of improvement in both underground and surface installations adopted by Witherbee, Sherman & Co. has had a very beneficial effect on the mining industry which will continue to be felt for a long time in the future. During the past year attention has been directed specially to increasing the efficiency of the various plants, rather than to adding further equipment. The most extensive changes have been undertaken in the old mill, and when completed it is hoped that the milling capacity will be sufficient to handle the full quota of ore. The new mill has worked very successfully. An improved Ball-Norton separator of the

endless belt type, perfected at Mineville, has been installed in place of the machines formerly used, and has been found to be well adapted for treating the highly phosphoric ore from the Old Bed. The arrangement of the magnets in series of alternating polarities, which characterizes this separator, imparts a constant vibratory motion to the particles of ore as they pass from one magnet to another and gives the entangled gangue matter opportunity to free itself. With its use the Old Bed ore, which carries about 60% iron and often 1.5 or 2% phosphorus, is concentrated to a product assaying over 65% iron and from .5 to .7% phosphorus. The tailings made in the process are re-treated in Wetherill separators, which recover a further portion of the magnetite that goes into the first concentrates. They also take out the hornblende as a middlings product. The other components of the original ore consist mostly of apatite and quartz and constitute the tailings from the Wetherill machines. The tailings analyze about 12% phosphorus, or 60% tricalcium phosphate; they form a valuable by-product which is sold to fertilizer manufacturers. The hornblende tailings also contain phosphorus to the extent of 7 or 8%, but they are mostly held in reserve at present.

A feature of interest in connection with these mines is the extensive use of electric power for driving the various plants, as well as for lighting, pumping and hoisting in the mines. A large central power house erected in 1903 furnishes most of the electric current that is required. The generator is of alternating type, 750 kw capacity, and is directly connected with a 1000 h.p. Nordberg-Corliss engine. A second power house containing a 200 h.p. engine and 150 kw generator supplies current to the old mill. The company has also an electric generating station at Wadhams Mills on the Bouquet river, the power from which is transmitted to the mines and used to supplement the regular supply.

The Mineville ore, though mostly of non-Bessemer character, finds a ready market in the Eastern States. The blast furnaces in this section use it as a basis for mixture with the hematite ores from Lake Superior or local mines in making foundry irons. The concentrates shipped from Mineville are unusually high in content of iron and can be utilized to advantage with leaner ores. The more phosphoric magnetite from the Old Bed workings is in demand by makers of basic Bessemer iron; a large quantity of this ore was exported last year to Germany.

The Northern Iron Co. blew in its furnace at Port Henry late in 1904, after making extensive repairs. The output is about 200

tons of pig iron daily. Most of the ore is furnished by the Port Henry Iron Ore Co. from Mine 21.

Arnold Hill mines. The Arnold Hill magnetite mines, situated on the Ausable branch of the Delaware & Hudson Railroad, have been active during the past year. The deposits were among the first to be exploited in the region, but till 1850 the output was made by opening pits along the outcrop. The ore is found in several parallel veins of lenticular shape which overlap and are separated by various thicknesses of wall rock. Sometimes two or more veins can be attacked from a single stope. The ore belongs to two types, "blue vein" which is a rich martite and "black band" or magnetite. At present the mines are worked by the Arnold Mining Co. of Harkness. The two shafts, known as the north and south shafts, are located about a mile from the railroad. A concentrating plant has been erected at Arnold Station, to which the ore is conveyed from the mine by a gravity plane. The ore as mined is first crushed to coarse size and concentrated on Ball-Norton machines. It is then passed through rolls and reconcentrated.

Lyon Mountain. The Lyon Mountain deposits lie on the Lake Placid branch of the Delaware & Hudson Railroad and are operated by the Chateaugay Ore & Iron Department of this company. They comprise a series of large veins or impregnations in the country, the whole forming an ore zone that extends fully five miles on the strike. In all there are about 25 openings, but only 8 are now worked. The inclined shafts or slopes have been sunk to a maximum of 1600 feet on the dip or about 800 feet vertically. As a rule the ore carries about 40% magnetite. It is concentrated to an average of 66% iron, with the remarkably low phosphorus content of .007%. A part of the ore is smelted by the company, and the remainder is shipped to Pennsylvania furnaces. It yields high grade Bessemer iron.

In the vicinity of Lyon Mountain, no. 81 mine at Standish has been idle for the last two years. Its ore is similar to that described above, and the deposit may belong to the same zone. The Parkhurst mine near Bradley pond and the Williams mine between the latter and Lyon Mountain yield a richer ore, but it contains more phosphorus. At Clayburg, Redford and other localities in the Saranac valley, there are a number of ore beds that were once worked for making iron by the bloomery process, and some interest is being shown in their re-opening, which will depend largely on the extension of railroad facilities.

Salisbury. The magnetite mine near Salisbury Centre, Herkimer county, was a small producer of ore in 1904. The deposits had been worked previously, but never on a large scale. They are lens-shaped bodies in syenite country, with basic hornblende gneiss as the immediate wall rock. The nearest point of shipment is Dolgeville, the terminus of a short railroad running north from Little Falls.

The Hematite mines. The production of hematite last year was confined to a single locality in St Lawrence county and to two localities in the Clinton deposits.

The Rossie Iron Ore Co. has opened three mines in the vicinity of Spragueville between Gouverneur and Antwerp. The ore occurs in the form of lenticular masses associated with crystalline limestone and serpentine. It carries from 40 to 45% iron and as shipped runs about 50%. A portion of the product is ground for paint and mortar colors.

The properties near Caledonia, St Lawrence co., formerly owned by the Carney Ore Mining Co., have been taken over by the Hudson Iron Co. and will be reopened during the coming year. They yield specular ore assaying 48 to 50% iron.

The mines and furnaces of the Franklin Iron Manufacturing Co. at Clinton, Oneida co., were closed down throughout the year. The only ore produced at this locality came from the property of C. A. Borst and was used in the manufacture of paint, largely by the Clinton Metallic Paint Co.

At Furnaceville, Wayne co., the Furnaceville Iron Co. continues to work its mines in the Clinton formation.

Limonite and carbonate mines. Though at one time of great importance, the limonite mines in Columbia and Dutchess counties have gradually succumbed to competition with richer and more favorably situated districts. The Salisbury region of which they form a part long enjoyed a high reputation for the quality of its iron, which was used in gun forgings, car wheels and other materials requiring great strength and tenacity. Even so late as 1883 there were not less than 20 charcoal furnaces employing these ores. In all some 25 mines have been opened and worked within the limits of the two counties. The output of the ore for the census year 1880 was reported at 144,878 long tons. In 1904 there was only one mine working which produced about 5000 tons.

The Burden carbonate mines have been idle for the past three years. From 1882 to 1901 they were operated by the Hudson River Ore & Iron Co., which equipped them with a very complete

mining plant. The ore varied from phosphoric to Bessemer in quality, but special attention was given to the latter. A railway $3\frac{1}{2}$ miles long conveyed the ore to the Hudson river near Catskill Station, where it was roasted and shipped to furnaces in New York, New Jersey and Pennsylvania.

MILLSTONES

The quarries of Ulster county continue to furnish the chief supply of millstones made in the United States. At one time the output from this section amounted to over \$100,000 annually, but recently it has averaged much less. The introduction of rollers, ball mills and other improved types of grinding machinery has been responsible for the decreased use of millstones.

The Ulster county or Esopus millstones are quarried from the Shawangunk grit, a light gray quartz conglomerate found along the Shawangunk mountains from near High Falls southwest towards the Pennsylvania border. In thickness and texture the rock varies greatly from place to place. The inclosed pebbles range from pea size up to an inch and more in diameter. The matrix is silicious paste of gritty character. Though of wide extent, only a small portion of the conglomerate is so situated that it can be utilized economically. Most of the stone is produced along the northern edge of the mountain where it lies close to the surface. The greater number of quarries are located in the vicinity of Kyserike, St Josen, Granite and Kerhonkson, while the distributing points for the finished product include New Paltz and Kingston in addition to those named. The industry is carried on intermittently, many of the producers engaging in other occupations during a part of the year.

The blocks obtained by quarrying are first roughly shaped by wedges and then dressed to size. The diameter of the millstones as marketed ranges from 15 to 90 inches. The greater demand is for the small and medium sizes with diameters of 24, 30, 36, 42 and 48 inches. A pair of 30 inch stones commonly sells for \$15, while \$50 may be paid for a single stone 60 inches in diameter. Besides the ordinary millstones a portion of the product is worked up into disks, which are used in a roll type of crusher known as a chaser. The pavement of such crushers is also supplied from the quarries in the form of blocks measuring 12 x 12 x 10 inches. The chasers are employed in grinding quartz, feldspar and barytes. Though the demand for millstones has shown a decided falling off since the introduction of the roller mill process for grinding

cereals, their use in other industries has been slowly increasing during the last 10 years. The small corn mills distributed throughout the Southern States still furnish an important market.

In the year 1904 the output of millstones in Ulster county was valued at \$21,476. The production was smaller than in the previous year, owing principally to the dullness in the cement trade. There were 18 firms actively engaged in the business.

MINERAL PAINT

The varieties of mineral paint that are made from materials mined in New York State include metallic paint, mortar colors, slate pigment and sienna.

For metallic paint and mortar colors some form of iron ore, generally hematite or limonite, is commonly employed, but only a few localities are known where the ore possesses the requisite qualities of color and durability. The fossil hematite from the Clinton formation has been found to be well adapted for the purpose and is the material most widely used in this country. The ore is derived from mines at Clinton, Oneida co., and Ontario, Wayne co. Shales and slates containing large amounts of iron oxid are also ground and sold for metallic paint. The principal supplies come from near Randolph, Cattaraugus co., and Eagle Bridge, Rensselaer co.

The product known as mineral black is made by grinding dark colored slate found in the Hudson river region; and the red slate of Washington county is used to some extent as a pigment.

Sienna, a variety of ocher, occurs near Whitehall. The deposit is a thin bed in glacial drift and has been worked on a small scale.

The production of mineral paint in 1904 was as follows: metallic paint and mortar color, 4740 short tons, valued at \$55,768; slate pigment, 3132 short tons, valued at \$23,876. These totals include only the output made within the State from local materials and do not represent the full importance of the industry, since some of the raw product is shipped elsewhere for manufacture. An output of 6970 tons was reported by three firms, who sell the crude ore and slate to paint grinders.

The following companies were engaged in the mining or manufacture of mineral paints during 1904.

NAME	LOCATION OF OFFICE
Algonquin Red Slate Co.	Worcester Mass.
Charles A. Borst	Clinton
Clinton Metallic Paint Co.	Clinton

NAME	LOCATION OF OFFICE
The William Connors Paint Mfg. Co.	Troy
Elko Paint Co.	Randolph
A. J. Hurd	Eagle Bridge
Rossie Iron Ore Paint Co.	Ogdensburg
Andrew Ruff	Troy
Samuel Ruffell	Ontario

MINERAL WATERS

The mineral springs of New York afford a variety of waters suited for medicinal or domestic purposes. Over 200 different springs have been listed and classified according to their mineral composition, although many have no commercial value except as sources of local water supply. Some of the springs are places of resort for tourists and health seekers.

Among the various waters found in this State those containing salts of the alkalis and alkaline earths are the most important. The celebrated Saratoga springs fall in this class and are further characterized by the presence of carbon dioxide. They supply great quantities of table and medicinal waters which are shipped to almost every part of the country. The Sharon and Massena springs are also saline, but differ from the former in containing sulfureted hydrogen. Richfield Springs is a noted locality for chalybeate sulfureted waters which are employed in medicinal baths as well as for drinking purposes. At Oak Orchard is found a rare type of spring containing free sulfuric acid. Thermal springs are represented by the Lebanon spring which is chalybeate and has a temperature of about 75°. Besides the foregoing there are a number of other localities where mineral springs occur and are utilized to a greater or less extent. Quite a large industry exists also in the sale of spring waters which contain very little mineral salts, their value depending upon their freedom from obnoxious impurities. The Great Bear Spring at Fulton may be mentioned as an example of this class.

In the following list are included the names of the leading mineral springs in the State and their location. Nearly all are employed in the commercial production of mineral waters or have recently been so employed.

NAME	LOCATION
Baldwin Mineral Spring	Cayuga, Cayuga co.
Chemung Spring	Chemung, Chemung co.
Rockdale Mineral Spring	Rockdale, Chenango co.
Lebanon Mineral Spring	Lebanon Springs, Columbia co.

NAME	LOCATION
Mount View Spring	Poughkeepsie, Dutchess co.
Ayers Amherst Mineral Spring	Williamsville, Erie co.
Avon Spring	Avon, Livingston co.
Jackson's Sanitarium	Dansville, Livingston co.
Clinton Lithia Spring	Franklin Springs, Oneida co.
Franklin Lithia Spring	Franklin Springs, Oneida co.
Glacier Spring	Franklin Springs, Oneida co.
Lithia Polaris Spring	Boonville, Oneida co.
Split Rock Spring	Franklin Springs, Oneida co.
Verona Mineral Springs	Verona, Oneida co.
Warner's Natural Mineral Spring	Franklin Springs, Oneida co.
Clifton Springs	Clifton Springs, Ontario co.
Geneva Lithia Mineral Water Spring	Geneva, Ontario co.
Geneva Red Cross Lithia Spring	Geneva, Ontario co.
Fitzsimmons Spring	Port Jervis, Orange co.
Deep Rock Spring	Oswego, Oswego co.
Great Bear Spring	Fulton, Oswego co.
Oswego Mineral Spring	Oswego, Oswego co.
White Sulphur Springs	Richfield Springs, Otsego co.
Massena Springs	Massena Springs, St Law. co.
Arondack Spring	Saratoga Springs, Saratoga co.
Artesian Lithia Spring	Ballston Spa, Saratoga co.
Congress Spring	Saratoga Springs, Saratoga co.
Empire Spring	Saratoga Springs, Saratoga co.
Eureka White Sulphur & Mineral Spring	Saratoga Springs, Saratoga co.
Excelsior Spring	Saratoga Springs, Saratoga co.
Geyser Spring	Saratoga Springs, Saratoga co.
Hathorn Spring	Saratoga Springs, Saratoga co.
Hides Franklin Spring	Ballston Spa, Saratoga co.
High Rock Spring	Saratoga Springs, Saratoga co.
Lincoln Spring	Saratoga Springs, Saratoga co.
Old Putnam Mineral Spring	Saratoga Springs, Saratoga co.
Patterson Mineral Spring	Saratoga Springs, Saratoga co.
Quevic Spring	Saratoga Springs, Saratoga co.
Remeho Spring	Saratoga Springs, Saratoga co.
Royal Vichy Spring	Saratoga Springs, Saratoga co.
Star Spring	Saratoga Springs, Saratoga co.
Saratoga Seltzer Spring	Saratoga Springs, Saratoga co.
Saratoga Vichy Spring	Saratoga Springs, Saratoga co.

NAME	LOCATION
Saratoga Victoria Spring	Saratoga Springs, Saratoga co.
Chalybeate Spring	Sharon Springs, Schoharie co.
Magnesia Spring	Sharon Springs, Schoharie co.
White Sulphur Spring	Sharon Springs, Schoharie co.
Red Jacket Mineral Spring	Seneca Falls, Seneca co.
Mountain Mist Spring	West Hills, Suffolk co.
Dryden Springs	Dryden, Tompkins co.
Big Indian Spring	Ellenville, Ulster co.
Elixir Spring	Clintondale, Ulster co.
Vita Spring	Fort Edward, Washington co.
Clyde Mineral Spring	Clyde, Wayne co.

The commercial production of mineral waters constitutes a large and growing industry. For the year 1904 the revenue derived from their sales amounted approximately to \$1,600,000, representing a total of 8,000,000 gallons. The springs in Saratoga county alone reported sales of 1,695,936 gallons valued at \$419,364. In regard to the totals given, it may be stated that they include estimates for certain springs in lieu of more definite information. The canvass of the industry is attended with a good deal of difficulty owing to the fact that many springs are exploited intermittently or on a small scale and no accurate account is kept as to the sales. A number of springs, also, are used locally to supply hotels and sanatoriums, so that only a nominal value can be placed on their output.

Carbonic acid gas

Carbon dioxid, or carbonic acid gas as it is commonly known, is produced in commercial quantities at Saratoga Springs. The gas accompanies the mineral waters, sometimes in such quantity as to force the latter to the surface, but frequently the flow is assisted by pumping. In all about 30 wells have been drilled for gas, their depths ranging from 150 to 600 feet.

The water is removed to the mouth of the well and the gas conveyed to a holder from which it is drawn off for charging into cylinders. The carbon dioxid contains a small quantity of air and frequently a trace of hydrogen sulfid, but it is said to be, on the whole, much purer than that produced by artificial means.

According to information furnished by J. C. Minor jr, the total supply of carbon dioxid from the wells in the vicinity of Saratoga Springs is about 20,000 pounds per day of which only about one half is at present recovered. The product is employed principally in the manufacture of soda waters. The following companies, all of

Saratoga Springs, have been engaged in the production of carbon dioxid during the past year: New York Carbonic Acid Gas Co.; Natural Carbonic Gas Co.; Lincoln Spring Co.; Geysers Natural Carbonic Acid Gas Co.; and Champion Natural Carbonic Acid Gas Co.

NATURAL GAS

Natural gas has been found in New York over a wide area and at various geologic horizons. The most productive field is in the southwestern part, including Allegany, Cattaraugus, Chautauqua and Erie counties. Many of the adjoining counties to the east contain deposits, though of smaller extent, and there are a great number of wells within the belt bordering Lake Ontario from Jefferson to Niagara county. The first successful attempt to use natural gas for light and heat was made at Fredonia, Chautauqua co., where shallow wells were drilled as early as 1821.

The oil field of Allegany and Cattaraugus counties has produced large quantities of natural gas from Devonian strata. The gas occurs in the Bradford sand and the underlying Kane and Elk sands. Some of the supply is consumed in pumping the oil, while the remainder is used for light and fuel in the local towns and villages. The industry is controlled by a few companies who own the pipe lines. Olean, Wellsville, Andover, Gowanda, Friendship, Hornellsville and Geneseo are some of the leading towns supplied from this field.

In Chautauqua county the region bordering Lake Erie contains numerous deposits in the Portage and Chemung formations. The wells are mostly shallow, and the individual yield is only sufficient to supply a few families with gas. Attempts have been made to find larger deposits by drilling into the underlying strata. At Fredonia a well has been sunk below 2500 feet, encountering gas in the Medina sandstone, but the ventures have generally proved unremunerative.

The discovery of gas territory east of Buffalo has lately brought Erie county into prominence as a producer. One of the largest fields extends from Lancaster to Alden near the Genesee county line. Some of the wells have yielded as high as 1,000,000 cubic feet daily. The gas is supplied to Akron, Batavia, Lancaster, Depew, East Aurora, Honeoye Falls and other towns in the vicinity, as well as to Buffalo. The deposits are found in the Medina strata.

In Wyoming county a small output is made around Attica. Livingston county produces considerable quantities from wells at

Lima, Avon and Caledonia. Rushville, Yates co. and Gorham, Ontario co., have a few wells. Farther east in Onondaga county deposits have been found at Baldwinsville, Phoenix and Warner, and in Oswego county at Fulton, Pulaski and Sandy Creek. The latter occur in the Trenton limestone, the lowest horizon at which gas has been found in the State.

The returns received from the various producers of natural gas show that the total value of the output in 1904 amounted to \$552,197. Owing to the fact that some of the larger companies operate at several localities, it has been difficult to distribute the output according to the districts in which it was made. The following statistics are, however, close approximations: Alleghany-Cattaraugus field, \$183,830; Erie county, \$254,899; Chautauqua county, \$31,822; Niagara, Wyoming and Genesee counties, \$18,855; Livingston, Seneca, Ontario and Yates counties \$32,451; Onondaga county, \$15,350; Oswego county, \$14,990.

One of the notable developments during the year has been the opening of large wells at Silver Creek, Chautauqua co., by the Home and the South Shore gas companies. The wells are connected by pipe lines with Dunkirk and Forestville. At Westfield a deep well is being drilled with the view of exploring for gas in the formations below the Devonian. The Brocton Gas & Fuel Co. of Brocton drilled two wells during the year. In the first well, which reached a depth of 2263 feet, the Medina sandstone was encountered at 2225 feet, and gave a flow of about 10,000 cubic feet daily. A pocket of sulfurous gas was found between the depths of 400 and 600 feet. The second well was sunk to 2261 feet below the surface, but yielded only sulfurous gas from the Devonian strata. In Erie county the Springville Gas Co. put down several wells near Springville and Collins. The property of the Genesee Natural Gas Co. of Genesee has been taken over by the Empire Gas & Fuel Co.

PETROLEUM

The oil-bearing territory of New York embraces the northeastern extension of the Appalachian field. The Bradford district, which reaches its widest development in Pennsylvania includes a small area in Cattaraugus county, and there are several pools in Allegany county forming the Allegany field, though they are sometimes grouped with the Bradford. The productive strata are fine grained sandstones of dark brown color, locally called "black sands." They belong to the Chemung formation of the

Upper Devonian. The petroleum varies from amber to black in color, and usually contains a large proportion of lubricating oils.

The first well in New York was drilled at Limestone, Cattaraugus co. in 1865. The Alleghany field was opened some 15 years later. In 1902 there was a total of 8443 producing wells in the territory,¹ while the number drilled since the beginning largely exceeds that figure. Compared with other oil fields of the country, the records indicate that the wells have a very long life, but their average yield is small, being less than one half barrel per day. The industry is favored, however, by the superior grade of oil produced, which commands a high price at the refineries, and by the occurrence of gas in quantities that generally suffice to furnish the power necessary for pumping. During the last few years the market conditions have been unusually satisfactory and have stimulated activity in working the wells and in the exploration for new territory.

The output of petroleum in 1904 as indicated by the shipments of companies operating pipe lines in the State amounted to 1,036,179 barrels of 42 gallons. At an average of \$1.65 per barrel, the value of the production was \$1,709,770. Since 1890 the output has fluctuated within narrow limits, the totals varying little from that of last year. The following companies have pipe lines in New York territory: The Alleghany Pipe Line Co., Columbia Pipe Line Co., Union Pipe Line Co. and the Vacuum Oil Co., of Wellsville N. Y., and the Tide-Water Pipe Co. Limited, of Bradford Pa.

PYRITE

The mining of pyrite has been carried on intermittently in New York State for several years, but the production has never attained much importance. The only deposits that have been worked recently are in the vicinity of Canton and Gouverneur, St Lawrence co. The ore is low grade, running from 30 to 35%, but by concentration the sulfur can be brought up to 45 or 50%. It is free from objectionable impurities and well adapted for acid burning. Considering the fact that the deposits are favorably situated with regard to market, it would seem that they are worthy of greater attention than has been given them. The sulfite paper mills in this section of the State consume large quantities of sulfur in the form of sulfurous acid, and there is no apparent reason why it should not be supplied by the local mines.

¹Bureau of the Census. Mines and Quarries. 1902.

The Stella mine which has produced most of the ore mined in this section during recent years was inactive in 1904. A new company has acquired the property with a view to restarting operations. The mine formerly owned by the High Falls Pyrite Co. has been taken over by the National Pyrite Co. of Canton. The Adirondack Pyrite Co. worked its mine near Gouverneur during a part of the past season. A new deposit has been opened at Richville by B. R. Hutchings. The total production of pyrite in 1904 was 5275 long tons valued at \$20,820.

SALT

Salt has long been one of the chief mineral products of the State. In point of value the annual output is exceeded only by that of clay materials, stone and cement. The New York industry is favorably situated with regard to the large markets and has been able to maintain its commercial prominence, notwithstanding the more recent developments in other sections of the country.

The salt deposits, which are associated with the Salina beds of the Upper Siluric, occur over a wide area. Their northern extent, as shown by the outcropping Salina strata, is defined approximately by a line drawn from a point somewhat south of Oneida lake westward to Buffalo. To the south the deposits are encountered at progressively increasing depths in accordance with the dip of the strata, which ranges from 25 to 40 feet to the mile. The most easterly point where wells have been sunk is at Morrisville, Madison co. Between this point and Lake Erie, salt has been found in almost all of the central tier of counties. The wells around Syracuse produce a natural brine that is stored in glacial gravels, but elsewhere the deposits are rock salt.

In Onondaga county, Syracuse continues to be an important center of the industry. The manufacture of salt began there in 1789 and in 1797 it came under State control. For a long time the wells yielded nearly all of the salt made in the State, but in late years there has been an increasing output from other localities. A noteworthy feature, also, has been the falling off in the production of the finer grades of salt. Almost the entire yield at present is of the solar or coarse variety. The largest operator in Onondaga county is the Solvay Process Co. The company derives its supply of brine from wells in the town of Tully, 20 miles south of Syracuse. The deposits are rock salt, and the brine is obtained by bringing fresh water into the wells. Formerly the brine was allowed to flow out under its own pressure,

but owing to the loss from percolation with this method, the wells are now pumped. The brine is conveyed by pipe line to the works at Solvay, where it is used for the manufacture of soda products.

In Tompkins county, wells were sunk at Ludlowville in 1891 and 1892 and at Ithaca in 1895. At the latter locality the salt deposits had an aggregate thickness of over 250 feet and were found at depths below 2240 feet. In 1899 the wells came under the control of the National Salt Co. by whom they have since been operated. More recently the Remington Salt Co. has erected a plant near Ithaca and has engaged in the manufacture of salt. The company has drilled three wells, finding the deposits at about 2100 feet below the surface.

Salt is obtained in Schuyler county around Watkins. The Glen Salt Co. sank the first well in 1893 and encountered a deposit at a depth of 1840 feet. The company was later merged into the National Salt Co. The Watkins Salt Co. also operates at this locality.

The discovery of salt near Wyoming, Wyoming co. in 1878 furnished an incentive for the exploration of this region. The first well penetrated 70 feet of rock salt at 1270 feet from the surface. It was followed by discoveries at Warsaw, Leroy, Rock Glen, Batavia and at numerous places in Livingston, Wyoming and Genesee counties. Practically the whole valley of Oatka creek, from Leroy to Bliss and the Genesee valley south of Monroe county have been found to be salt bearing. The region is now one of the most productive in the State. The National Salt Co. has operated three plants at Warsaw. The other active companies in this field are the Empire State Salt Co. of Leroy; the Worcester Salt Co. of Silver Springs; the Retsof Mining Co. of Retsof and the Oatka Mining Co. of Wyoming. The last named company began development work in 1903 and will produce rock salt. A large number of plants have been erected by other companies that are now inoperative.

In Erie county salt has been found at Eden Valley, Springville and Gowanda, but these localities are no longer productive. At Perry, the Iroquois Salt Co. has a plant which has been operated during the last few years.

Among other discoveries of salt in New York may be mentioned those at Vincent and Naples, Ontario co.; Dundee, Yates co.; Seneca Falls, Seneca co.; and Aurora, Cayuga co. The deposits are not worked.

All of the principal grades of salt are made in New York, including coarse solar, common coarse, common fine, table and dairy, packers and rock salt. The coarse solar is produced entirely at Syracuse where great areas of land are given up to its manufacture. Rock salt is mined in quantity at Retsof and Livonia. Most of the remaining product is marketed as common fine, common coarse and table and dairy salt.

Production and trade in 1904. During the year 1904 there were 30 companies engaged in manufacturing salt in the State. Of this number Onondaga county was represented by 23, Wyoming and Tompkins county by two each, and Genesee, Livingston and Schuyler by one each. The National Salt Co. is included under Tompkins county, but it has operated also in Schuyler and Wyoming counties. No new companies entered the list of producers during the year.

The total output of salt in 1904 amounted to 8,724,768 barrels of 280 pounds. In the total, account is taken of the amount of salt utilized in the form of brine for the manufacture of soda products, which is a very important item. The value of the output was \$2,102,748 or 24 cents a barrel. The following table shows the production distributed among the various grades as marketed.

Production of salt by grades in 1904

	Barrels	Value	Value per barrel
Common fine ^a	1 309 531	\$409 498	\$.31
Common coarse.....	423 686	142 357	.33
Table and dairy.....	1 160 423	518 742	.45
Coarse solar.....	459 156	175 931	.38
Packers.....	46 178	14 180	.31
Other grades.....	5 325 794	842 040	.16
Total.....	8 724 768	\$2 102 748	\$.24

^a The common fine salt includes some coarse salt, so that the division for these grades is not quite exact.

The total for "other grades" is made up principally of rock salt and salt used for soda manufacture, but includes other kinds. It will be noted that the value of this salt is much lower than the general average.

Of the total output, Onondaga county contributed 3,456,337 barrels valued at \$233,477, while the remainder, consisting of

5,268,431 barrels valued at \$1,869,271, came from Livingston, Wyoming, Schuyler, Tompkins, and Genesee counties in the order of their rank.

The production last year compares well with previous records, and, when considered in connection with the expansion which the industry has recently undergone, it shows that the manufacture of salt in New York is carried on under very stable conditions. The season on the whole was rather unfavorable to producers. The demand in the larger markets was not equal to the supply, and there was a good deal of competition among the companies. The output of solar salt at Syracuse was adversely affected by the weather, which was unusually cloudy and wet throughout the summer. The report of the State Superintendent of the Onondaga Salt Springs, states that the production showed a decline of about 200,000 bushels from the total of the previous year. The quantity of salt inspected was 1,743,388 bushels of 56 pounds each, of which 1,608,298 bushels were made by the solar process, and 135,090 bushels by artificial evaporation. In 1903 the quantity inspected was 1,933,224 bushels. There were 22 producers in Syracuse and vicinity. The output is all handled by the Onondaga Coarse Salt Association of that city.

The most noteworthy change in the trade during the year was the merging of the works owned by the National Salt Co. into the International Salt Co. The former company had been in the hands of receivers since 1902. The International Salt Co. which also operates the Retsof rock salt mine, assumed control of the properties on Aug. 1, 1904. The offices of the company are in New York city. During the year the following plants of this company were active: Glen works, Watkins; Ithaca works, Ithaca; Cayuga works, Myers; Hawley, Warsaw and Yorkshire works, Warsaw.

SLATE

Quarries of roofing slate are worked in Washington county near the Vermont state line. The productive district includes a narrow belt running nearly due north from Salem through the towns of Hebron, Granville, Hampton and Whitehall. Efforts have been made to work slate in other parts of the State, particularly in the Hudson river metamorphic region, but for reasons no longer apparent they have not led to the establishment of a permanent industry. Hoosick, Rensselaer co., New Lebanon, Columbia co., and New Hamburg, Dutchess co., are among the places that have furnished slate in the past. At the locality

last named, beds were found which yielded large blocks resembling the Welsh slate in color and quality and adapted for structural material, billiard tables, blackboards and other purposes. They were operated as late as 1898.

The slate from Washington county exhibits a variety of colors. Red is the most valuable and is the characteristic product of the region. Owing to its rarity elsewhere, it has a wide sale and is in constant demand for export. This variety is found near Granville and in the Hatch Hill and North Granville districts between North Granville and Whitehall. Its occurrence is confined to areas of Lower Siluric age. Purple, variegated and different shades of green slate are produced from Cambrian areas, principally around Middle Granville, Salem and Shushan. The unfading green, which also commands a good price for roofing purposes, is quarried to some extent in Washington county, but the greater quantity comes from across the border in Vermont.

Up to the present time the production of slate for other than roofing purposes such as mantels, billiard tables, floor tiling, blackboards, etc., has not been developed to any extent in this section. It is an important branch of the slate trade of Pennsylvania and Vermont, and there is no doubt that increased attention to this branch would greatly assist the advancement of the industry.

The reports received for 1904 show that 10 firms were engaged in quarrying slate during the year. The total output was 18,090 squares of roofing slate, valued at \$86,159, and \$7441 of mill stock. Compared with the previous year the statistics indicate a decline of about 15% in the combined value of both products, due almost entirely to the smaller quantity of mill stock made. The roofing slate averaged \$4.76 a square, which is higher than the general run of prices received in other slate-producing regions. Of the quantity given, about 6000 squares were red slate.

Among the leading producers in 1904 were the following:

NAME	LOCATION OF OFFICE
Mathews Consolidated Slate Co.	Poultney Vt.
Algonquin Red Slate Co.	Worcester Mass.
Granville Slate Co	Granville N. Y.
Montauk Slate Co	Middle Granville N. Y.
John W. O'Brien	Middle Granville N. Y.
Allen & Williams	Middle Granville N. Y.

The McCormick Red Slate Co., the Bonanza Slate Co., and the Beck Slate Co., of Granville and Charles I. Baker of Truthville have opened quarries and will work them during the present year. The Welsh Red Slate Co. of Poultney, Vt., which formerly operated quarries at Hampton, has retired from business.

STONE

All of the principal building and ornamental stones are quarried in New York and most of them on a large scale. In the following pages a brief description is given of their occurrence throughout the State, together with information relating to production and developments during the past year. The slate and millstone industries which might properly be included here have been treated under separate headings owing to their somewhat special character.

Production of stone

The value of the quarry products for 1904 amounted to \$5,124,251. This sum covers the output of all varieties of stone excepting slate and millstones and that portion of the limestone which was used for the manufacture of hydraulic cement. It represents the aggregate product of over 600 quarries.

The value of the limestone production was \$2,058,405. The sandstone quarried amounted in value to \$1,896,697, of which the greater part was reported by companies engaged in the bluestone trade. The output of trap rock, mostly from the Hudson river Palisades, was valued at \$468,496; marble at \$478,771; and granite at \$221,882. Classified as to uses, crushed stone was the most important item in the production. The value of this material amounted to \$1,557,974, representing approximately 2,224,000 cubic yards. Building stone accounted for \$1,254,548, while curb and flagstone were produced to the value of \$908,280. The monumental stone quarried was valued at \$165,935. The value of the stone quarried for purposes other than those given was \$1,237,514.

As noted in the accompanying table, the totals for building stone, crushed stone and curbstone do not include certain items which should be classified under these heads, but the results are not appreciably affected thereby.

Production of stone in 1904

Variety	Building stone	Monumental	Curbing and flagging	Crushed stone	All other	Total value
Granite.....	\$80 300	\$11 262	a	\$83 295	\$38 025	\$221 882
Limestone...	248 647	.....	\$6 253	994 475	809 030	2 058 405
Marble.....	278 994	154 673	a	a	45 104	478 771
Sandstone...	637 607	.....	902 027	27 583	329 480	1 896 697
Trap.....	a	.....	.....	452 621	15 875	468 496
Total...	\$1 254 548	\$165 935	\$908 280	\$1 557 974	\$1 237 504	\$5 094 251

Granite

The term granite, as here used, includes the crystalline rocks generally, with the exception of trap or diabase which is treated by itself.

There are two principal areas where these rocks occur in New York, the one being the Adirondack region and the other the lower Hudson valley. Massive granites are much less important in both areas than the banded or schistose types designated as gneisses and schists; they are sufficiently developed, however, to afford frequent sites for quarries. At present most of the granite employed for building, monumental and decorative purposes is brought in from other states, as the local production is far from meeting the requirements.

In southeastern New York, the Highlands of the Hudson consist almost entirely of granite and gneiss. Quarries have been opened at numerous localities, particularly along the river where convenient transport facilities can be had. In Putnam county, Breakneck mountain, just north of Cold Spring, supplies a medium grained gneissoid granite which has been used extensively for building material and crushed stone. At Garrisons a true granite of massive character outcrops and has furnished building stone to New York city. Farther south around Peekskill, there are several quarries producing gneissoid granite. In Westchester county granitic rocks are abundant and of varied character. One of the principal formations is the Fordham gneiss, a well foliated grayish biotite gneiss that has supplied much material for foundations and rough masonry. The quarry localities include Hastings, Lowerre, Bryn Mawr and Uniontown. The Yonkers gneiss, more massive than the former and containing hornblende, affords a durable building stone which is obtained at Dunwoodie and Scarsdale, while a similar rock occurs at Hartsdale, Hastings,

aSmall, included under "all other."

Tarrytown and White Plains. Dikes and bosses of massive granite are quite common and have been worked at New Rochelle, Mount Vernon, Lake Mohegan, Westchester co.; Round Island, Rockland co.; and at Pine Island, Orange co. The Cortland series of gabbros and diorites outcropping south of Peekskill may be mentioned among the quarry resources of this region.

The crystalline rocks of the Adirondacks extend over a great area, but their inaccessibility has prevented the opening of quarries, except on the borders. The varieties found here include massive granites, syenites, gabbros and anorthosites, as well as gneissoid phases of each.

Building and monumental stone is quarried quite largely in Jefferson county. Grindstone island, in the St Lawrence river, is noteworthy as a locality for red granite of very attractive appearance. The latter has a coarsely crystalline texture, takes a lustrous polish, and on account of its deep red color has been employed as a substitute for the Scotch granite. It is used for building and decorative purposes in many of the western cities and in Canada.

Production of granite in 1904

County	Building stone	Monumental	Crushed stone	Rubble, riprap	Paving, curbing
Jefferson.....	\$1 750	\$6 662	.....	.....	.....
Orange ¹	62 500	200	\$13 095	\$460	\$7 265
Westchester.....	24 550	400	7c 200	30 000	.....
Elsewhere.....	500	4 000	.....	300	.....
Total.....	\$89 300	\$11 262	\$30 295	\$83 760	\$7 265

At Little Falls, Herkimer co., there is an outlier of the Adirondack syenite which is worked to some extent. In Fulton county quarries have been opened at Mayfield and Northville, in Lewis county near Port Leyden and in Franklin county at St Regis Falls.

Anorthosite was quarried at one time near Keeseville, Essex co. The stone has a handsome chatoyant appearance when polished, and is adapted for monumental and decorative work.

The total value of the products from the granite quarries of the State amounted in 1904 to \$221,882. Of this sum building stone accounted for \$89,300; crushed stone for \$83,295; rubble and riprap for \$30,760 and monumental stone for \$11,262. The remainder amounting to \$7265, represented the value of paving

¹Includes Rockland county.

blocks and curbstone. Westchester county was the largest producer with an output valued at \$125,150. The value of the production in the other counties was as follows: Orange and Rockland \$83,520; Jefferson \$8412; Clinton and Fulton \$4800.

Limestone

The limestone quarries are the most important in New York State. Compared with sandstone, which ranks second in value of output, limestone is not especially prominent as a building material, but it is more generally used as road metal and concrete. Its wide occurrence, in connection with its natural fitness for the purpose, has favored the development of an extensive crushed stone trade that covers nearly every section of the State. The manufacture of lime also calls for a large part of the product.

Distribution. Among the geologic formations of the New York series, limestone appears frequently¹. In the Precambrian strata of the Adirondacks and in southeastern New York it has been metamorphosed and has the crystalline character of marble. The noncrystalline limestones, to which the present discussion is limited, are associated with the Lower Siluric, Upper Siluric and Devonian systems. Those chiefly exploited will be briefly described.

The Beekmantown limestone or calciferous sandrock, as it has been commonly called, occurs in isolated areas along the Mohawk and Champlain valleys. There are quarries in Warren, Montgomery, Fulton and Herkimer counties. It is a fine grained, massive stone of grayish color and normally contains more or less magnesia. This constituent sometimes occurs in sufficient amount to characterize the rock as dolomite. Owing to its prevailing silicious nature, the limestone can seldom be used for other than building purposes.

The Chazy limestone is of local importance. It is found along a narrow belt bordering the Adirondacks from Saratoga county north to Clinton county. In composition it is a typical limestone, containing little magnesia or impurities. For this reason it is adapted to the manufacture of lime. The stone has a finely crystalline texture, and at Chazy and Plattsburg has been quarried for marble. It supplies also some building stone and furnace flux.

In the Mohawkian or Trenton group are included the Lowville (Birdseye), Black river and Trenton limestones, which occupy

¹For fuller details as to the distribution and character of the limestones of New York reference is made to State Museum Bulletin 44, Lime and Cement Industries of New York, by Heinrich Ries.

a large area and possess considerable economic value. They occur in the Champlain valley, but mostly on the Vermont side, and on the southern and western borders of the Adirondacks. From the Mohawk valley at Little Falls they form a belt that extends northwesterly with gradually increasing width to the St Lawrence river. The area on the eastern side of Lake Champlain is continued southward into Washington county. The limestone varies somewhat in character according to locality and geologic position. It is often highly fossiliferous. The lower part of the group or Lowville formation is a heavy bedded limestone, but the upper beds commonly contain more or less shale. The color ranges from light gray to almost black. It sometimes shows incipient metamorphism and has a crystalline texture. The Trenton limestones are quarried in Clinton, Washington, Montgomery, Fulton, Herkimer, Oneida, Lewis and Jefferson counties. The product is used for building and road material and common masonry. A part is also burned into lime. At Glens Falls, Trenton limestone is employed for the manufacture of Portland cement.

The next group of limestones in ascending order is the Niagaran, which comprises the Lockport and Guelph formations. The latter is a typical dolomite, fine grained and of grayish color. It occupies a limited area in Monroe and Orleans counties, and is quarried near Rochester. It has been used for lime. The lower member of the group, the Lockport dolomite, outcrops in a continuous belt several miles wide from Niagara Falls east to Onondaga county, and then with diminishing width across Madison county. Like the Guelph it contains magnesia, and this component may be present in sufficient quantity to make it a dolomite. The lower part is usually silicious, grading into shale. The upper portion which is heavy bedded is adapted for building material, road metal, lime, etc. There are quarries around Niagara Falls and Lockport. It is also worked at Rochester and to some extent in Wayne, Onondaga and Madison counties.

The Cayugan group with its several members is noteworthy economically, as it contains the valuable gypsum and salt deposits besides the hydraulic limestones that are utilized for cement. The basal strata, comprising the Salina stage, are mostly shales, though they are interbedded with thin layers of dolomitic limestones. In the Cobleskill, Rondout and Manlius stages, limestones prevail. In the Rosendale district of Ulster county they have furnished large quantities of material for the manufacture of natural rock cement, and they are the source of the cement

rock in Onondaga and Schoharie counties. The purer limestones of the group are employed in Onondaga county for lime making.

At the base of the Devonian system, the Helderbergian group is prominent for its limestones. The latter are strongly developed along the Hudson river in Albany, Columbia, Greene and Ulster counties. The Coeymans or Lower Pentamerus formation affords rock suitable for lime, building stone and road material, while the Becraft or Upper Pentamerus is employed as an ingredient of Portland cement and for furnace flux. There are quarries at Hudson, Rondout, South Bethlehem and Catskill.

Of the remaining formations represented in New York, the Onondaga is the only one that is of much importance for limestone quarries. It outcrops in Orange, Ulster, Greene and Albany counties, and is exposed quite continuously through the middle and western part of the State. Building stone and lime are the principal products. Quarries have been opened at Kingston, Split-rock (near Syracuse), Auburn, Waterloo, Seneca Falls, Leroy and Buffalo, and many other places.

Production of limestone

The value of the limestone quarried in New York during 1904 amounted to \$2,058,405. This is exclusive of the limestone used in making Portland and natural cement, for which no statistics have been collected. There were 35 counties that reported an output with 157 quarries in all.

Production of limestone in 1904

Material	Quantity	Value
Crushed stone (cubic yards).....	1 471 395	\$994 475
Lime made (short tons).....	494 883	678 225
Furnace flux (long tons).....	140 198	75 419
Building stone.....	.....	248 647
Rubble, riprap.....	.....	22 230
Flagging, curbing.....	.....	6 253
Miscellaneous.....	.....	33 156
Total.....	.....	\$2 058 405

Crushed stone, for road metal, concrete and other purposes, represented the largest item in the production, the value of this material being \$994,475, or 48% of the total. The manufacture of lime was second in importance with a yield valued at \$678,225. Building stone was quarried to the extent of \$248,647. The remaining uses reported for the product were furnace flux, which

amounted in value to \$75,419; rubble and riprap, amounting to \$22,230, and flagging and curbing amounting to \$6253. In addition there were quarried miscellaneous materials, not classified in the returns, with a combined value of \$33,156.

Of the crushed stone a total of 443,037 cubic yards valued at \$318,383 was reported as used for road material. These figures, however, do not represent the whole amount employed for that purpose, as many of the producers were unable to classify their output.

The returns received show that Onondaga county has the largest quarrying industry. The total product in 1904 amounted in value to \$344,817, and was reported by 15 companies. The manufacture of lime is particularly important in the county, due mainly to the operations of the Solvay Process Co. Erie county with 13 active quarries made an output valued at \$295,722, consisting principally of building and crushed stone. The value of the production in Westchester county which ranked third in the list, was \$255,972, made by three companies. The other counties that reported a value exceeding \$100,000 were Genesee (\$222,702), Rockland (\$194,154) and Ulster (\$150,055).

Production of limestone by counties

County	Crushed stone	Lime made	Furnace flux	Building stone	Other uses	Total
Albany.....	\$47 872	\$1 125	.....	\$700	\$500	\$50 197
Cayuga.....	13 864	80	\$1 000	12 432	16 500	43 876
Clinton.....	10 666	55 175	4 019	1 950	2 750	74 560
Dutchess.....	12 383	.....	.....	187	.....	12 570
Erie.....	170 509	400	609	108 411	15 793	295 722
Fulton.....	6 840	1 500	.....	.....	.....	8 340
Genesee.....	150 210	4 500	64 299	3 500	193	222 702
Herkimer.....	150	8 582	.....	500	.....	9 232
Jefferson.....	7 570	60 580	.....	20 096	6 106	94 352
Madison.....	7 595	.....	.....	125	3 000	10 720
Monroe.....	27 035	.....	.....	6 050	2 000	35 085
Montgomery.....	81	.....	.....	7 022	1 000	8 103
Niagara.....	15 727	4 500	.....	6 300	3 875	30 402
Oneida.....	16 387	.....	.....	1 500	.....	17 887
Onondaga.....	41 481	275 923	2 525	22 333	2 555	344 817
Rockland.....	194 154	.....	.....	.....	.....	194 154
St Lawrence.....	2 600	8 100	.....	2 924	3 350	16 974
Saratoga.....	33 151	.....	.....	1 500	.....	34 651
Schoharie.....	13 181	312	24	24 495	2 780	40 792
Ulster.....	9 317	2 620	.....	.....	.....	11 937
Warren.....	442	131 800	.....	17 813	.....	150 055
Washington.....	10 110	36 000	.....	.....	.....	46 110
Westchester.....	182 372	72 800	800	.....	.....	255 972
Other countiesa..	20 778	14 228	2 143	10 809	1 237	49 195
Total.....	\$994 475	\$678 225	\$75 419	\$248 647	\$61 639	\$2 058 405

a Includes Allegany, Columbia, Essex, Greene, Lewis, Ontario, Orange, Orleans, Rensselaer, Seneca, Wayne and Yates.

Lime. There were 40 firms that reported an output of limestone (including marble) for lime burning, either as a main product or in connection with the quarrying of other materials. The greater portion of the limestone was converted by the companies operating the quarries. In all 21 counties participated in the production. The total quantity burned to lime amounted to 494,883 short tons, of which 381,974 short tons, or 77% was reported by four companies in Onondaga county. Warren county made 32,000 tons; Westchester 28,000; Jefferson 17,403; Clinton 15,873; and Washington county, 9000 tons. The remaining counties were small producers.

The value given for lime in the foregoing table is considerably less than the ruling commercial price for the year. This is due to the fact that the Solvay Process Co., the chief producer in the State, has placed a nominal valuation on its output, all of which is used as a reagent in the manufacture of soda products. Disregarding the quantity thus consumed, the average value of the lime made during the year was \$3.54 a short ton.

Crushed stone. The use of limestone for crushing has grown to enormous proportions. The total output in 1904 amounted to no less than 1,471,305 cubic yards. There were 28 counties represented in the returns received. The principal producing counties with the quantity made by each, in yards, were as follows: Westchester, 302,045; Erie, 286,658; Rockland, 258,873; Genesee, 252,224; Albany, 80,503 and Onondaga, 61,552. The price received for the material used in road making averaged 72 cents a cubic yard.

Building stone. The quarrying of building stone was less active during 1904 than in the previous year. The demand showed a marked decline, due principally to the labor troubles prevailing in the building trades. Very few of the quarries ship any quantity of stone to points without the State, so that the industry must depend for its support on the local markets. An improvement in the latter has already been manifested, and if continued it will doubtless exert a favorable influence on quarrying operations during the current year.

Erie county is the largest producer of limestone for building purposes. Its output in 1904 was valued at \$108,411 and was reported, for the most part, by quarries in the vicinity of Buffalo. Jefferson, Onondaga and Schoharie counties each made an output valued at over \$20,000.

Marble

Building and ornamental marbles occur extensively on the borders of the Adirondacks and in the metamorphic region of southeastern New York. Along Lake Champlain there are several localities where quarries have been opened and operated in the past, but the production from this section is not now of much importance. The dove-colored "Lepanto" and the "French Gray" marbles found near Plattsburg and the verd-antique marbles of Port Henry and Thurman are the varieties best known. At Glens Falls a black marble which takes a brilliant polish and is in demand for decorative purposes has been quarried for a number of years. On the western side of the Adirondacks a large quarrying industry has been developed around Gouverneur; the product varying from white to dark blue is used principally for monumental work. The white dolomitic marble from South Dover and Tuckahoe in southeastern New York is widely employed as building stone.

The total production of marble for the year 1904 was valued at \$478,771. The output was divided as follows: building marble, rough and dressed, \$278,994; monumental, rough and dressed, \$154,673; other purposes, \$45,104. Most of the marble used as building material came from Tuckahoe and South Dover, and the remainder was supplied from Plattsburg and Gouverneur. The last named locality was the largest producer of monumental marble, its production for the year being valued at \$144,934. In addition it produced building and other grades of marble valued at \$37,279. The output classified under "other purposes" includes crushed stone, rubble, riprap, curbing and marble dust. The amount burnt into lime is reported under limestone.

The following firms were active during 1904:

NAME	LOCATION OF OFFICE
Burlington Marble Co.	Burlington, Vt.
Extra Dark Marble Co.	Gouverneur
Finch, Pruyn & Co. Inc.	Glens Falls
Gouverneur Marble Co.	Gouverneur
F. W. Jones & Co.	Hudson
Peter Leyotte	Plattsburg
Northern New York Marble Co.	Gouverneur
O'Connell Lime & Marble Dust Co.	129 3d av. New York
Rylstone Marble Co.	Gouverneur
St Lawrence Marble Quarries	Gouverneur
South Dover Marble Co.	South Dover

NAME	LOCATION OF OFFICE
Watertown Marble Co.	Watertown
Waverly Marble Co.	1 Madison av. New York
White Crystal Marble Co.	Gouverneur
D. J. Whitney Marble Co.	Gouverneur

At Gouverneur there has been unusual interest shown in the development and extension of the quarrying industry and the outlook for the future is most encouraging. There were eight companies that reported an output during the year. With one or two exceptions the quarries of this section make a specialty of monumental marble, for which there is a steady market, while building marble is largely a side product that is supplied according to the current demand.

The prevailing type of marble is light gray to dark blue in color. When polished it resembles some of the gray granites and has a very beautiful appearance.

The Gouverneur Marble Co. has erected a new mill to replace the old plant which was destroyed by fire in July 1904. A portion of the equipment has already been installed and it will be increased till 11 gangs are working.

The property formerly owned by the St Lawrence Marble Co. was transferred to the St Lawrence Marble Quarries in November. The company owns two quarries and has one of the largest mills in the district.

The D. J. Whitney Marble Co. started its mill in April 1904, maintaining four gangs in operation. Its property is situated near the quarries of the Northern New York Marble Co., and both produce high grade dark monumental marble. The mill owned by the latter company is equipped with 10 gangs and includes a polishing department. The waste material is largely used by the Northern Crushed Stone Co., which operates a crushing plant near the quarry.

The Watertown Marble Co. has taken over the quarry of Davidson Brothers near Gouverneur and the E. E. Stevens quarry at Canton. Its mill located at Watertown is equipped with 15 gangs and will be enlarged during the current year. The company makes a specialty of monumental and decorative work.

A new mill of 10 gangs has been erected at the quarry recently opened by the Rylstone Marble Co. near Gouverneur. Productive operations were begun late in the year. The company will give its attention chiefly to building material.

The Clarkson quarry near De Kalb Junction which has been worked under lease by W. D. Chamberlain has been transferred

to the Clarkson Marble Co. It is intended to add new equipment and to commence operations during the present season.

In the Lake Champlain region the only producers have been Peter Leyotte of Plattsburg and the Burlington Marble Co.

The Glens Falls Co. of Glens Falls was succeeded by Finch, Pruyn & Co.

In southeastern New York, the South Dover Marble Co., the Waverly Marble Co., F. W. Jones & Co., and the O'Connell Lime and Marble Dust Co., were active. The last named company uses its output for manufacturing lime and marble dust.

Sandstone

Under this heading are included all sedimentary rocks that are made up of granular quartz. Among the principal varieties distinguished by textural characters are sandstones proper, conglomerates, grits and quartzites.

The wide distribution of sandstones in the geologic series of New York State has given them great importance as economic sources of structural materials, and in point of annual output they rank second only to limestones. Nearly all of the main formations above the Archean contain sandstones at one or more horizons. The general properties and occurrence of the most important of these rocks are here briefly reviewed.

Potsdam sandstone. The Potsdam or Upper Cambrian is the oldest formation in which quarries have been opened in the State. It is developed most extensively on the borders of the Adirondacks. In the Champlain valley it outcrops at frequent intervals from Fort Ann northward to the Canadian boundary. On the southern side it is not so well represented, though there are few exposures, best shown in Fulton and Saratoga counties. Along the northern edge of the Adirondacks from Lake Champlain to the St Lawrence river, a broad band of Potsdam crosses Clinton, Franklin and St Lawrence counties and reaches well into Jefferson. It is in this section, chiefly around Potsdam, that the largest quarries have been opened.

The Potsdam, typically, is an even grained sandstone of reddish color, hard and compact. Owing to the cementation of the component grains by secondary deposition of quartz, it combines great strength with low absorptive powers, making it one of the most durable building stones known. The comparative isolation of the quarries from the large cities and the slightly increased cost of dressing the stone due to its abnormal hardness have operated,

however, to restrict the market for Potsdam sandstone notwithstanding its excellent qualities.

Hudson river sandstone. The Hudson river series which was once assigned a definite position in the geologic scale is now recognized to be a complex of beds ranging from middle Trenton to Lorraine age. Inasmuch as the various horizons have not been delimited yet on the map, the name may be conveniently retained in its former areal significance.

The rocks belonging to this group are found in the Hudson river valley from the Highlands northward to Glens Falls and along the Mohawk to Oneida county whence they extend around the western Adirondacks through Lewis into Jefferson and Oswego counties. Shales, slates, sandstones and conglomerates are represented. The sandstones are usually thinly bedded, argillaceous and of grayish color. They have little importance except for local markets and their use is mostly limited to rubble and common masonry work. No large quarries supplying this stone are in steady operation at present.

Medina sandstone. The Medina formation comprises a great thickness of sandstones extending in a wide belt from the central part of Oneida county westward along the border of Lake Ontario to Niagara river. A smaller area outcrops in Orange and Ulster counties. The stone is usually gray, red or mottled in color with medium to coarse texture. It shows fair crushing strength and is an attractive building stone. The quartz grains are partially replaced at times by decomposed feldspar but seldom in such an amount as to injure the quality of the stone.

The flat, even bedding and the regular jointing which usually characterize the Medina, facilitate its working, while its occurrence in a populous district has promoted the growth of a large quarrying industry. The most productive field of operations lies on the southern edge of the belt and extends from Brockport, Monroe co., through Holley, Hulberton, Hindsburg, Albion, Eagle Harbor, Medina and Shelby Basin, Orleans co., to Lockport and Lewiston, Niagara co. Albion, Hulberton and Medina are the chief quarrying centers at present. The quarries are well equipped and their combined capacity largely exceeds the output. There is a wide demand for the stone as building material, though the market has been curtailed to some extent in recent years by active competition with the Berea sandstone of Ohio. It finds employment also for curbing and flagging and specially for paving blocks for which purpose it takes the place of granite and trap.

Devonic sandstones. The Hamilton, Portage, Chemung and Catskill formations of the Upper Devonian, comprise alternating beds of sandstones and shales that are developed in great strength throughout the central and southern parts of the State.¹ Their northern limit is approximately defined by a line beginning near the Hudson river, a few miles below Albany, and extending north of west in a broad curve to a short distance south of Syracuse and thence almost directly westward to Lake Erie. On the east they follow the Hudson valley from Albany county to near Kingston, in Ulster county, where they bend to the southwest and continue in this direction till they enter Pennsylvania. The sandstone from these formations is popularly known as bluestone, a name first applied to the Ulster county stone on account of its color. Though the original significance can no longer be claimed for the name as used commercially, the more or less persistent characters of Devonian sandstones and their employment for common purposes warrant the adoption of some such collective term.

Quarries have been opened at various localities within the above defined area. The region which has undergone most active operations, however, is that on the southeast which is more favorably situated in relation to markets and convenience of transport. The greater number of quarries have been opened on the eastern slopes of the Catskills, in the outlying ridges between the latter and the Hudson river and in the hills bordering the Delaware river. This district includes parts of Albany, Greene, Ulster, Sullivan, Delaware and Broome counties. As a rule the industry is carried on by small operators who sell their product to dealers located in the neighboring towns along the Hudson river and the Erie and Ontario & Western railroads. Among the chief shipping points are Catskill, Greene co.; Saugerties and Kingston, Ulster co.; Walton, Hancock, Lordville, Hale Eddy and Fishs Eddy, Delaware co.; Rockland, Livingston Manor and Long Eddy, Sullivan co.; and Deposit, Broome co.

In addition to this region there are many localities in the central and western counties of the State which produce bluestone. A large output is made around Oxford and Norwich, Chenango co. and Rock Glen, Wyoming co. Among other places, quarries have been opened at Ithaca, Trumansburg, Kings Ferry, Portageville, Amity and Scio.

In its prevailing type, bluestone is even bedded, compact, fine grained and dark blue or bluish gray in color. It splits easily along

¹The sandstones of this region have been treated very fully in Museum Bulletin 61, by Harold T. Dickinson.

the bedding planes and is particularly adapted for flagstones, curbing and house trimmings and other purposes for which a smooth surface is desirable. It lends itself readily to mill treatment. More than one half of the annual output is sold in the form of flag and curbstone and most of the remainder as building material, including both rough and dressed.

The bluestone from this region finds its largest market in the cities along the Atlantic seaboard. The product from the Hudson river district is transported by barges to New York, Philadelphia, Boston and intervening points. The output of Delaware, Sullivan and Broome counties goes in part to New York, Philadelphia and vicinity and in part to the interior cities of the State. It is handled mainly by the Erie and the Ontario & Western railroads. The other quarries depend mostly on local markets for the sale of their output.

Production and trade in 1904

The total value of the sandstone quarried in New York last year was \$1,896,697. This output was distributed among 31 counties with an aggregate of over 400 producers. Classified as to uses the total was distributed as follows: building stone, rough and dressed, \$637,607; curbing and flagging, \$902,027; paving blocks, \$293,252; crushed stone, \$27,583; rubble, \$14,736; all other purposes, \$21,492. The crushed stone amounted approximately to 34,948 cubic yards of which 13,400 yards, valued at \$10,665, was for road material and 20,548 yards, valued at \$16,918, for concrete, railroad ballast, etc. It has not been possible to separate the building stone according to the amount sold rough and dressed or to report the flagging and curbing separately, owing to the fact that many of the quarrymen keep no detailed account of their operations.

The following table shows the value of the production of sandstone in 1904 distributed among the leading districts of the State. It also indicates the relative proportion of bluestone to the other sandstones that were quarried.

Production of sandstone in 1904

District	Building stone	Curbing and flagging	Paving blocks	Crushed stone	Rubble, riprap	All other
<i>Bluestone</i>						
Hudson river....	\$99 114	\$352 240	\$13 394	.....	.....	\$44
Delaware river...	117 806	310 913	.....	.....	\$3 218	5 043
Chenango county.	85 710	24 100	.....	.....	.....	1 000
Wyoming county.	175 072	300	.....	.....	500	1 502
Other districts....	4 390	16 255	.....	\$1 390	100	163
Total bluestone.	\$482 092	\$703 817	\$13 394	\$1 390	\$3 818	\$7 752
<i>Sandstone</i>						
Orleans county...	\$115 000	\$185 526	\$274 846	.....	\$1 900	\$11 500
Other districts....	40 515	12 684	5 012	\$26 193	9 018	2 240
Total sandstone	\$155 515	\$198 210	\$279 858	\$26 193	\$10 918	\$13 740
Combined total	\$637 607	\$902 027	\$293 252	\$27 583	\$14 736	\$21 492

The value of bluestone quarried for all purposes in 1904 was \$1,212,263 or approximately 64% of the total sandstone; the value of other sandstones quarried was \$684,434 or 36% of the total.

The production of bluestone by districts was as follows: Hudson river, \$464,801; Delaware river, \$436,980; Wyoming county, \$177,374; Chenango county, \$110,810; elsewhere, \$22,298. Of the sandstone quarried Orleans county reported an output valued at \$588,772 and other counties an output valued at \$95,662.

A more detailed classification of the product that would cover each county separately has been found impracticable, since many of the large companies who operate quarries at several localities are unable to divide their output according to the different sources. The relative rank of the principal counties of the State, was, however, as follows in the order of their importance: Orleans, Ulster, Delaware, Wyoming, Sullivan, Chenango and St Lawrence.

The foregoing table shows that of the bluestone quarried along the Hudson river, in Albany, Greene and Ulster counties, about 75% in value was sold as curbstone and flagstone and about 22% as building stone. In the Delaware river districts, including Sullivan, Delaware and Broome counties, the value of the flagstone and curbstone sold amounted to 70% and building stone to 27% of the total. In Chenango and Wyoming counties, on the other hand, almost the entire output was marketed as building stone, the value of flagstone and curbstone being less than 6% of the total sales. The output of Medina sandstone in Orleans county was used chiefly

for the following purposes: building stone, 20%; flagging and curbing, 32% and paving blocks, 47%.

Trade notes. The Medina Quarry Co., the largest operator in the Medina district, was succeeded during 1904 by the Orleans County Quarry Co. with offices at Albion. The former company was organized in 1902 and took over a number of quarries with a view of combining their operations. The quarries are located at Albion, Medina, Eagle Harbor, Holley and Hulberton. Among the products sold are building stone, flagstone, curbstone and paving blocks.

There have been few changes of note in the bluestone trade. With some exceptions the quarrying is done by small concerns employing but few men and their operations are more or less of transitory character. Nearly all of the product from the Hudson river and the Delaware river regions is handled by dealers who also own or lease much of the land on which the quarries are located.

The principal dealers along the Hudson river who market most of the product from Ulster and Greene counties are the following:

NAME	LOCATION OF OFFICE
Hudson River Bluestone Co.	Rondout
John Maxwell's Sons	Saugerties
Smith & Yeager	Catskill
Ulster and Delaware Bluestone Co.	Kingston

In Delaware, Sullivan and Broome counties, comprising the Delaware river region, the leading dealers and quarriers are:

NAME	LOCATION OF OFFICE
E. J. Cotter	Hancock
Deposit Stone Co.	Deposit
George W. Kazenstein	Hancock
Kirkpatrick Bros.	Hancock
Sutton & Connor	Walton
P. J. Maden	Deposit
James Nevins' Sons	Fishs Eddy
Cyrus Peak	Long Eddy
Randall Bros.	Hancock
John Rhodes	East Branch
Standard Bluestone Co.	Jersey City N. J.
Travis & Kingsbury	Hale Eddy

The producers in other districts of the State include the following important firms:

NAME	LOCATION OF OFFICE
Cusack & Murray	Kings Ferry
Dunn & Mead	Oxford
F. G. Clarke Bluestone Co.	Oxford
American Bluestone Co.	Warsaw
Warsaw Bluestone Co.	Warsaw
Theodore Woods	Norwich
Genesee Valley Bluestone Co.	Bluestone
Driscoll Brothers & Co.	Ithaca
Peter O'Hara	Trumansburg

The general condition of the quarrying industry during 1904 has been fairly satisfactory. The demand for structural stone was somewhat below normal, as in the previous year, for which the depression prevailing in the building trade in the larger cities was responsible. An improvement in the demand will probably manifest itself during the present year. The bluestone market, on the other hand, was active and absorbed an unusually large output.

Trap

The basic dike rocks, commonly called trap, are found at numerous places throughout the Adirondacks and adjacent territory. The largest area in the State, however, is that which outcrops along the lower Hudson southward from Haverstraw, constituting the remarkable scenic feature known as the Palisades. This ridge crosses the Rockland county line into New Jersey, but appears again on the north shore of Staten Island. The trap is a dark, fine grained, crystalline aggregate of plagioclase, augite and magnetite. It properly belongs to the diabase rock group. It is exceedingly hard and tough, and, unlike most granitic rocks, shows little tendency to rifting or parting along planes of weakness, so that it is admirably adapted for paving blocks and road metal, of which the ability to withstand constant wear is an essential feature. Though the rock has been used to some extent in buildings, it is too unyielding in the quarry to be extensively employed for that purpose.

The principal quarries of trap are those at Rockland Lake, operated by the Clinton Point Stone Co. and the Rockland Lake Trap Rock Co., those at Upper Nyack and Haverstraw worked by the Manhattan Trap Rock Co., and the Long Clove Trap Rock Co., respectively, and the quarries at Port Richmond, Staten Island, worked by the Quinroy Contracting Co. Each company operates crushing plants in connection with the quarries. The

crushed stone is used for road metal, concrete, railroad ballast, etc. A test of the trap from Rockland Lake made in the laboratory for road material at Washington D. C. gave the following results: Coefficient of wear, 13.2; per cent of wear, 3; weight in pounds a cubic foot, 192.5; pounds of water absorbed a cubic foot, .3; cementing value, 80.

The production of trap rock in New York last year was valued at \$468,496. Of this total, \$452,621 represented the value of crushed stone, and \$15,875 the value of paving blocks and building stone. The total quantity of crushed stone made was 610,285 cubic yards, of which 280,516 cubic yards was reported as sold for road metal, while the remainder was unclassified. The paving blocks were quarried on Staten Island.

TALC

No important developments in the talc industry of St Lawrence county were recorded during 1904. The mines and mills have been working at a normal rate, in accordance with the market demand for the product, which was of average character as compared with previous years. With existing facilities the output could be increased to much larger than present proportions so that there is little incentive to start new enterprises in this field.

The market for fibrous talc is limited almost entirely to the requirements of paper manufacturing, and since it scarcely seems probable that the other uses can be augmented to any great extent, the demand, doubtless, will continue to be governed by the conditions prevailing in that industry. So far as the American paper trade is concerned, St Lawrence talc has become a staple article, but there is still some room for extending the foreign consumption, particularly in Great Britain where manufacturers have been slow to recognize its advantages over other fillers. Germany is the best of foreign markets and large quantities of the product are exported annually to that country. That it can compete successfully with the high grade German clays sold at lower prices lends encouragement to the view that the exports may be further increased.

The superior qualities of talc from this region are primarily due to its fibrous, pliable character. Thus in paper making it not only serves as a filler, but the fibers felt together and strengthen the paper stock. A much larger proportion of fibrous talc can be incorporated in the pulp than is possible with clay or other materials composed of scaly or rounded particles. Among the chief

consumers are manufacturers of book, writing and wall papers. The mills making newspaper use relatively smaller quantities than is generally supposed. It is stated that some prejudice exists on their part against talc from this region owing to the grit which is usually present. This impurity is objectionable for the reason that it increases the wear of the machines, particularly when run at high speed, as in newspaper mills.

The production of talc in 1904 amounted to 65,000 short tons. The average selling price at Gouverneur on the basis of car load lots was \$7 a ton, at which figure the total output was worth \$455,000. There were four companies in the field, the same as in the previous year. The International Pulp Co. had three mines and the same number of mills in steady operation, with an additional mill running part of the time. The United States Talc Co. and the Ontario Talc Co. each operated one mine and mill, while the Union Talc Co. ran two mines and three mills.

On the basis of present prices, the margin of profit in the talc industry is by no means excessive. Owing to the character of the material and the nature of its occurrence, the mining cost is comparatively high. The fact that in most deposits there is a great deal of waste in the form of foliated and gritty talc adds materially to the cost of production. Machine drills are used to some extent for breaking down the rock, but they have little, if any, advantage as regards economy over hand drilling. With the former, work must be frequently suspended to clean the holes as the drills bind quickly in the soft but tough rock. After sorting at the mines the talc is transported to the mills, most of which are run by water power.

Milling is a tedious and expensive operation. The final grinding is done in a tube mill consisting of a horizontal steel cylinder 6 feet in diameter and 8 to 10 feet long, lined with enamelled brick. Three tons or more of flint pebbles are used in the cylinders, and the grinding continues for four or five hours. The rock is previously prepared for the cylinders by Blake crushers and Griffin mills. The latter have superseded buhr stones, which were formerly used almost exclusively.

ZINC

The zinc-lead mine at Ellenville, Ulster co., has been under development during the past year. The production of ore was limited to that obtained during the course of exploratory work and no commercial shipments were made. The operations have been under the direction of the Backus Lumber Co. of Newark N. J., who took over the property in 1901.

The Ellenville mine was first opened about 50 years ago since which time it has been operated intermittently by different companies. It is a noted locality for beautiful quartz crystals. The deposit consists of a fissure vein intersecting the Shawangunk grit. The width of the vein averages about 6 feet. Quartz is the principal gangue mineral, while the ore consists of sphalerite, galena and chalcopyrite in varying proportions. Silver accompanies the galena to the extent of a few ounces a ton.

The workings comprise an inclined shaft that has been carried down to about 200 feet on the vein and a series of levels 30 feet apart. A mill for treating the ore has been erected near the mine. Before smelting the concentrates must be subjected to a separation, which the company plans to effect by magnetic methods.

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New York State Education Department

New York State Museum

PUBLICATIONS

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These reports are made up of the reports of the director, geologist, paleontologist, botanist and entomologist, and museum bulletins and memoirs, issued as advance sections of the reports.

Geologist's annual reports 1881-date. Rep'ts 1, 3-13, 17-date, O; 2, 14-16, Q.

The annual reports of the early natural history survey, 1837-41, are out of print.

Reports 1-4, 1881-84, were published only in separate form. Of the 5th report 4 pages were reprinted in the 30th museum report, and a supplement to the 6th report was included in the 40th museum report. The 7th and subsequent reports are included in the 41st and following museum reports, except that certain lithographic plates in the 11th report (1891) and 13th (1893) are omitted from the 45th and 47th museum reports.

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12 (1892)	\$.50	17	\$.75	21	\$.40
14	.75	18	.75	22	.40
15, 2v.	2	19	.40	23	<i>In press</i>
16	1	20	.50		

In 1898 the paleontologic work of the State was made distinct from the geologic and was reported separately from 1899-1903. The two departments were reunited in 1904.

Paleontologist's annual reports 1899-1903.

See fourth note under Geologist's annual reports.

Bound also with museum reports of which they form a part. Reports for 1899 and 1900 may be had for 20c each. Those for 1901-3 were issued as bulletins. In 1904 combined with geologist's report.

Entomologist's annual reports on the injurious and other insects of the State of New York 1882-date.

Reports 3-19 bound also with museum reports 40-46, 48-57 of which they form a part. Since 1898 these reports have been issued as bulletins. Reports 3-4 are out of print, other reports with prices are:

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1	\$.50	9	\$.25	15 (En 9)	\$.15
2	.30	10	.35	16 (" 10)	.25
5	.25	11	.25	17 (" 14)	.30
6	.15	12	.25	18 (" 17)	.20
7	.20	13	.10	19 (" 21)	.15
8	.25	14 (En 5)	.20	20	<i>In press</i>

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Botanist's annual reports 1867-date.

Bound also with museum reports 21-date of which they form a part; the first botanist's report appeared in the 21st museum report and is numbered 21. Reports 21-24, 29, 31-41 were not published separately.

Separate reports 25-28, 30, 42-50 and 52 (Botany 3), are out of print. Report 51 may be had for 40c; 53 for 20c; 54 for 50c. Since the 55th these reports have been issued as bulletins.

Descriptions and illustrations of edible, poisonous and unwholesome fungi of New York have been published in volumes 1 and 3 of the 48th museum report and in volume 1 of the 40th, 51st, 52d, 54th and 55th reports. The descriptions and illustrations of edible and unwholesome species contained in the 40th, 51st and 52d reports have been revised and rearranged, and, combined with others more recently prepared, constitute Museum memoir 4.

NEW YORK STATE EDUCATION DEPARTMENT

Museum bulletins 1887–date. O. To advance subscribers, \$2 a year or 50c a year for those of any one division: (1) geology, economic geology, mineralogy, (2) general zoology, archeology and miscellaneous, (3) paleontology, (4) botany, (5) entomology.

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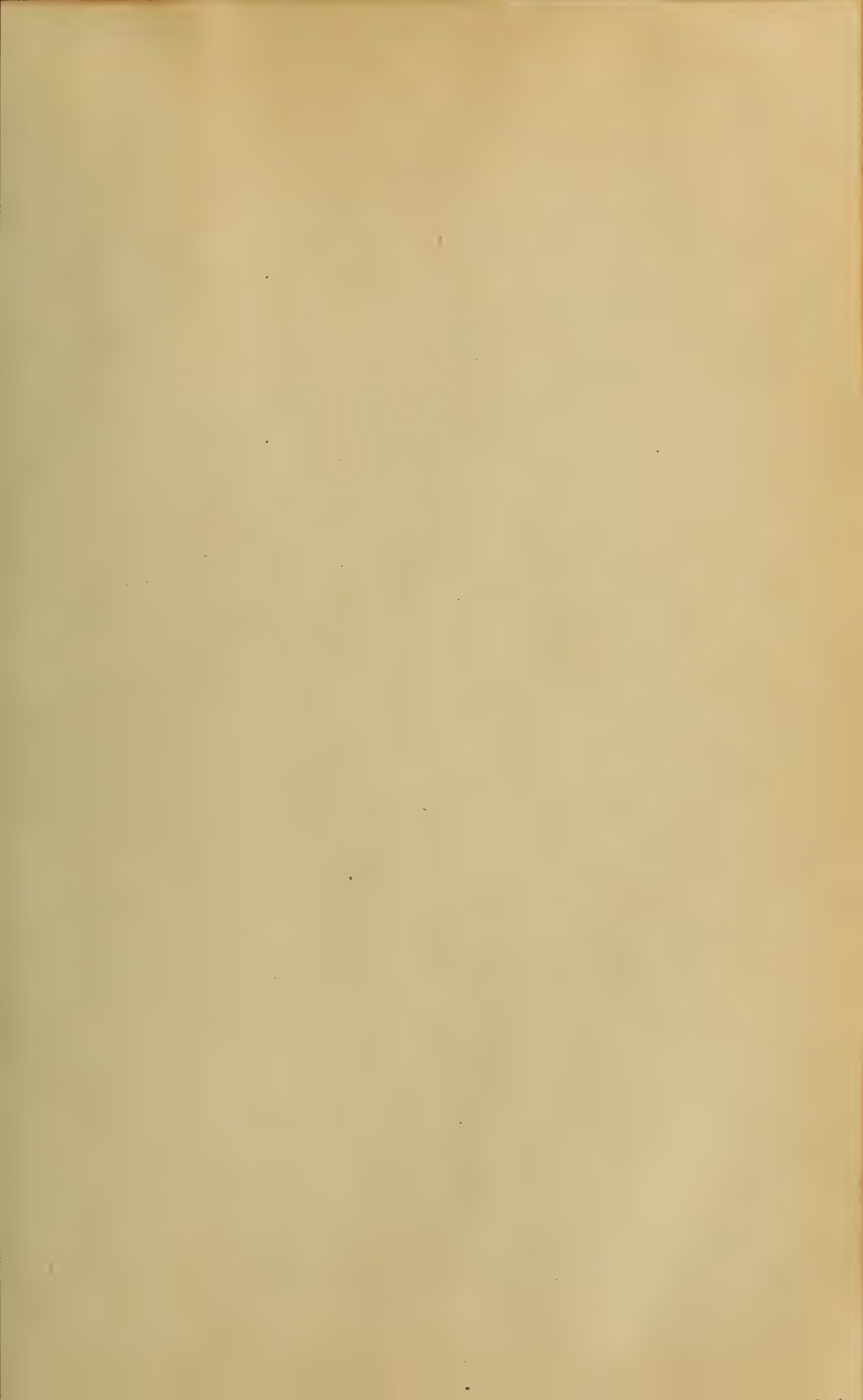
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